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Operation and Maintenance Manual

Interim Groundwater Recovery and Treatment System Naples Truck Stop Naples, Utah

Contract No. DACW45-90-D-9002 Delivery Order No. 88

Prepared for:
Department of the Army
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Omaha District
Omaha, Nebraska



Prepared by: IT Corporation Monroeville, Pennsylvania

RESPONSIVE TO THE NEEDS OF ENVIRONMENTAL MANAGEMENT

TO BE REVIEWED

Interim Groundwater Recovery and Treatment System Operation and Maintenance Manual Naples Truck Stop Naples, Utah

Contract No. DACW45-90-D-9002 Delivery Order No. 88 Project No. 519063

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1.0 Introduction

1.1 General Description

The Naples Truck Stop is located on U.S. Route 40 in Naples, Utah. The Interim Groundwater Recovery and Treatment System (IGRTS) is designed to recover groundwater and soil vapor impacted by gasoline which has leaked from an underground pipeline located on the Naples Truck Stop property. The main focus of the recovery activities is on the property of the Questar Pipeline Company (Questar), located adjacent to the Naples Truck Stop. The IGRTS consists of ten recovery wells located on Naples Truck Stop and Questar property, two vacuum enhanced pumping systems to recover groundwater and vapor from these wells, and a biological treatment system to destroy volatile organic compounds (VOC) in the water and vapor prior to discharge.

The treatment is required prior to discharge in order to meet discharge limitations set by the Ashley Valley Water and Sewer Improvement District for discharge of water to the storm sewer and by the Utah Department of Air Quality for discharge of vapor to the atmosphere. The discharge requirements are:

Liquid Less than 25 mg/L of VOCs and Oil & Grease

pH greater than 5.5

Vapor Less than 2,000 pounds of VOCs per year (for

operation without an air discharge permit)

Sampling and monitoring requirements are described in greater detail in Chapter 4.0 of this manual. A copy of the letter that serves as the Publicly Owned Treatment Works (POTW) discharge permit issued by the Ashley Valley Water and Sewer Improvement District is included in Appendix A.

Recovery Well RW-1 is a 6-inch diameter stainless steel well, with a total depth of 17 feet, and a screened interval of 10 feet from the bottom. The remaining recovery wells are 4-inch diameter polyvinyl chloride (PVC) wells, with total depths ranging from 16 to 19 feet, and screened intervals of 10 feet (RW-2 through RW-6) and 15 feet (RW-7 through RW-10) from the bottom. Figure 1 is a site plan showing the locations of the recovery wells and the system underground piping arrangement.

Vapor and liquid are extracted from the recovery wells by two vacuum enhanced pumping (VEP) systems. Each VEP system consists of a vacuum pump, an air/water separation tank, a water transfer pump, and a seal water recycle tank. Liquid and vapor are transferred from the two VEP systems to the biological treatment system, for removal of VOCs. The biological treatment system consists of three biological reactors (the third reactor was initially a fluidized activated carbon adsorber), a nutrient feed system, two vapor transfer blowers, an effluent water holding tank, and an effluent water transfer pump.

With the exception of the 12,000-gallon biological reactor (Biobed No. 1) located outside in a containment dike, the IGRTS equipment is located indoors. All of the indoor equipment but the nutrient feed system is located in the treatment building. The nutrient feed system is located in the control shed, adjacent to the treatment building. The layout of the IGRTS equipment is shown in Figure 2. Process and instrumentation diagrams (P&IDs) for the system are presented in Figures 3, 4, and 5.

The system is designed to operate automatically with intermittent supervision by an operator. The system is equipped with an autodialer that calls a series of pager numbers and any other relevant telephone numbers in the event of a system failure or other alarm condition. Control panels for the extraction and treatment system equipment are mounted in the control shed. Field panels FP-1, FP-2, FP-3 and FP-4 control the two VEP systems, and control panel CP-1 controls the remaining equipment.

1.2 Document Purpose

The purpose of this operation and maintenance (O&M) manual is to provide normal operating conditions and troubleshooting and maintenance guidelines for the IGRTS at the Naples Truck Stop site. The manual contains log sheets to aid operators in tracking system performance and maintenance (Appendix B). The completed sheets should be maintained at the site with this manual. Manufacturers' literature for the equipment and instrumentation used in the system is located in Appendix C of this manual.

Site personnel are expected to become familiar with this manual and to consult it when questions arise. This manual should be maintained on file at the site and be available to anyone responsible for operating or repairing the system.

1.3 General Safety Concerns

The primary safety concerns associated with the operation and maintenance of this system are exposure to the VOCs in the groundwater and the potential for explosion presented by the organic vapors. The impacted groundwater may be harmful if ingested or absorbed through the skin. It is recommended that site personnel wear gloves while performing any tasks that may involve contact with impacted groundwater. After any contact with these solutions, hands and any wetted skin should be washed with soap and water as soon as possible. Personnel should also avoid inhaling vapors in the treatment building. The treatment building and the control shed are equipped with ventilation fans and louvers. The ventilation fan in the treatment building should be operating at all times.

Maintenance work being performed on electrical equipment or instrumentation must be done after shutting off and locking out power to the equipment or instrument. Because the treatment building is classified as a Class 1, Division 1, explosive area, only explosion-proof and non-sparking tools may be used in the building. All electrical components inside the buildings are designed to meet these requirements.

2.0 Component Descriptions

2.1 Recovery Wells

Groundwater, and vapor are extracted from ten recovery wells (RW-1 through RW-10); six of these wells (RW-1 through RW-6) are located in the Questar parking lot; two wells (RW-7 and RW-8) are located in the Questar storage yard on the opposite side of 1620 East Street; and two wells (RW-9 and RW-10) are on Naples Truck Stop property, behind the restaurant. The wells are connected to the vacuum enhanced pumping systems (located in the treatment building) by 2- and 3-inch underground schedule 40 PVC pipe, as shown in Figure 1. The sump pump located in the treatment building sump is also included in this section of the O&M manual.

2.1.1 Equipment and Instrumentation Nomenclature

The hand valves in the IGRTS are labeled on the P&IDs. The following is a list of abbreviated names for the equipment and instrumentation included in this section:

Equipment/Instrumentation Item	Name
Recovery well 1	RW-1
Vacuum indicator at RW-1	VI-001
Sightglass on the line from RW-1	SG-001
Recovery well 2	RW-2
Vacuum indicator at RW-2	VI-002
Sightglass on the line from RW-2	SG-002
Recovery well 3	RW-3
Vacuum indicator at RW-3	VI-003
Sightglass on the line from RW-3	SG-003
Recovery well 4	RW-4
Vacuum indicator at RW-4	VI-004
Sightglass on the line from RW-4	SG-004
Recovery well 5	RW-5
Vacuum indicator at RW-5	VI-005
Recovery well 6	RW-6
Vacuum indicator at RW-6	VI-006
Recovery well 7	RW-7
Vacuum indicator at RW-7	VI-007
Sightglass on the line from RW-7	SG-007
Recovery well 8	RW-8
Vacuum indicator at RW-8	VI-008
Sightglass on the line from RW-8	SG-008
Recovery well 9	RW-9
Vacuum indicator at RW-9	VI-009
Sightglass on the line from RW-9	SG-009
Recovery well 10	RW-10
Vacuum indicator at RW-10	VI-010
Sightglass on the line from RW-10	SG-010
Sight glass on the line from RW-4, RW-5, and RW-6	SG-101
Sight glass on the line from RW-9 and RW-10	SG-102
Sight glass on the line from RW-1, RW-2, and RW-3	SG-201
Sight glass on the line from RW-7 and RW-8	SG-202
Control panel for the biological treatment system	CP-1
Treatment building sump pump	P-4
High-high level switch in building sump	LSHH-501
Indicating light for high-high level in building sump (CP-1)	LT-501

2.1.2 Operating Description

The streams from recovery wells RW-4, RW-5, and RW-6 are combined in a 3-inch header which is connected to another 3-inch header from wells RW-9 and RW-10 inside the treatment building. The common line discharges into the air/water separator tank located on VEP Skid 1. The streams from RW-1, RW-2, and RW-3 are combined in a 2-inch header which is connected to a 3-inch header from RW-7 and RW-8 inside the treatment building. This common line discharges into the air/water separator tank located on VEP Skid 2.

The flow from each well is controlled by adjusting the rate at which water is slugging out of the well using the gate valve located at the well head. Accurate adjustment of the flow of air and/or water from a recovery well is not possible. The rate at which air and water are recovered from each well is a function of the other recovery wells on line and the behavior of the fluids in the buried recovery piping. The vacuum on the recovery pipe from each well is displayed on the vacuum indicator located at the well head (VI-001 through VI-010). The vacuum applied to the well casing can be measured by attaching a portable manometer to the manometer connection on the well casing. These two measurements can provide long-term operating condition data and can be of limited use during system start-up.

During normal operation, the treatment building sump pump (P-4) operates automatically. When the selector switch for the pump (located on CP-1) is placed in the "AUTO" position, the operation of the pump is controlled by the float connected to the switch on the pump. The pump transfers water from the treatment building sump to the influent line to Biobed No. 1. If the water level in the building sump reaches a high-high level, an indicating light on CP-1 will be illuminated, and the "Biological Treatment System Shutdown" (BTSS) contacts will be activated. This set of contacts signals FP-3 and FP-4 to shut down both vacuum extraction systems.

2.1.3 Interlocks

There are no electrical interlocks associated with the recovery wells or the treatment building sump pump.

2.1.4 Alarms

Below is a summary of the recovery well and treatment building sump conditions for which alarms are set to activate:

Condition

Alarm

High-high water level in the building sump

- Building sump high-high level alarm light LT-501 (CP-1.)
- Activates autodialer Alarms 1, 2, and 3.

2.1.5 System Start-up

The handswitch for the treatment building sump pump (P-4) should be left in "AUTO" at all times unless maintenance is being performed on the pump. Start-up of P-4 consists of the following step-by-step instructions:

- Open the ball valve on P-4 discharge (HV-501).
- Open the ball valve on the influent to Biobed No. 1 (HV-301).
- Close valves HV-502 and HV-503 on the influent line to Biobed No. 1.
- Verify that the hand switch for P-4 (located on CP-1) is in the "AUTO" position.
- Test the pump by manually lifting the float on the pump.

Start-up of the recovery well system consists of the following step-by-step instructions:

- Verify that the gate valves at the well heads (HV-001 through HV-010) are closed.
- Open HV-101 and HV-201 (the ball valves on the headers from recovery wells RW-4, RW-5, and RW-6; and RW-1, RW-2, and RW-3; respectively). Close HV-102 and HV-202 (the ball valves on the other two headers).
- Start-up the biological treatment system (see Section 2.3.5).
- Start-up both VEP systems (see Section 2.2.5).
- Open HV-004 and HV-001 (the gate valves at the well heads of RW-4 and RW-1) all the way.
- Allow the VEP systems to draw water from RW-4 and RW-1 until the water level in each well reaches the bottom of the recovery pipe and air begins entering the pipe (as seen in the local sight glass or as indicated by fluctuating vacuum readings). The water will now be drawn up the recovery pipe in slugs (i.e., "slugging").
- After RW-4 is slugging consistently, open HV-005 (the gate valve on RW-5) all the way. Close HV-004 as needed to keep RW-4 slugging and maintain a

minimum of 8 in. Hg of vacuum on well RW-5. Repeat this same procedure for RW-2 when RW-1 begins slugging.

- Wells RW-6 and RW-3 are brought on-line in the same fashion as RW-5 and RW-2 (see above). Adjust the gate valves on all the wells until all three wells on each skid are slugging consistently.
- When the first three wells on a skid are slugging, the second header (the one with two wells) can be brought on-line. For Skid 1, this means opening valves HV-102, HV-009, and HV-010. For Skid 2, this means opening valves HV-202, HV-007, and HV-008.
- When all ten wells are brought on-line, the gate valves on the well heads should be adjusted as necessary for 2-3 days to keep as many wells as possible slugging.
- The system is considered to be balanced when all ten wells are on-line and slugging periodically. Note: all ten wells may not slug simultaneously depending on process conditions. This phenomenon can not be avoided.

2.1.6 System Shutdown

The recovery wells and building sump pump system operate around the clock, 365 days a year. During normal operation, the system is shut down only for maintenance. The following are step-by-step instructions for shutdown of the recovery well system:

- Shut down the VEP systems (see Section 2.2.6).
- Close valves HV-101, HV-102, HV-201, and HV-202 (the ball valves on the four headers from the recovery wells, located inside the treatment building).
- Close valves HV-001 through HV-010 (the gate valves on the recovery lines at the well heads).

The recovery wells can be shut down individually, in groups, or completely. The building sump pump should be left in "AUTO" mode when the recovery wells are shut down. The sump pump should only be shut down for maintenance on the pump or the sump. The following are step-by-step instructions for shutdown of the treatment building sump pump:

- Place the selector switch for P-4 (located on CP-1) in the "OFF" position.
- Close HV-501 (the ball valve on the discharge of P-4).

2.1.7 Troubleshooting

In the event that the building sump pump does not start when the water level in the sump rises above the stainless steel float, the rod on which the float is attached may be stuck. Movement of the rod should be checked manually by raising and lowering the float. The handswitch for the pump (located on CP-1) and valves HV-501 and HV-301 should be checked to verify that they are in the proper positions in the event of a problem with the pump. If plugging in the pump is suspected, the pump can be removed from the sump by disconnecting the piping unions and removing the grate over the sump.

In the event that a problem is suspected with the extraction system, the VEP systems should be thoroughly inspected for trouble (See Section 2.2.7). If the problem is not associated with the VEP systems, the piping in each recovery well head should be inspected for leaks or signs of blockage. The valves and vacuum indicators in the well heads should also be checked for problems.

2.1.8 Maintenance

The following is a list of recommended maintenance actions associated with the recovery wells:

- Monthly, inspect piping in the well heads for leaks.
- Monthly, record the vacuum levels in the recovery lines from each well and on each well casing. Adjust gate valves as necessary to get as many wells as possible slugging.
- Monthly, manually activate float switch on P-4 and check that pump is operating properly.

2.2 Vacuum Enhanced Pumping Systems

Two VEP systems are used to recover groundwater and soil vapor from the ten recovery wells at the site. Based on the yield of the various wells, the system is configured such that each VEP system draws from five recovery wells. VEP system No. 1 draws groundwater and vapors from recovery wells RW-4, RW-5, RW-6, RW-9, and RW-10; VEP system No. 2 draws groundwater and vapors from RW-1, RW-2, RW-3, RW-7, and RW-8.

The VEP systems are located in the eastern half of the treatment building; Skid 1 is on the right and Skid 2 is on the left as seen from the front of the building. The VEP systems consist of the same components: a vacuum pump, an air/water separator tank, a water transfer pump, and a seal water recycle tank. The systems operate identically. The groundwater and soil vapor recovered by the VEP system are separated in the air/water separator tanks. The water transfer pumps, submersible pumps located in the air/water separator tanks, transfer water to the biological treatment system. Water from the seal water recycle tanks is drawn into the suction line of the vacuum extraction pumps. Seal water is necessary for the pumps to operate and to prevent damage which can result from running dry. Each tank requires approximately 0.5 gpm of city water throughput to ensure that the operating temperature of the vacuum pumps remains below 100°F. This is accomplished by draining water from the seal water tank to the building sump at a fixed rate and allowing the solenoid valve on the city water line to open as controlled by the level switches in the tank and allow water into the tank.

2.2.1 Equipment and Instrumentation Nomenclature

The hand valves in the IGRTS are labeled on the P&IDs. The following is a list of abbreviated names for the equipment and instrumentation included in this section:

Equipment/Instrumentation Item	Name
NEPCCO control panel with OFF/AUTO switches for vacuum pumps and 480-volt disconnect switch	FP-1
NEPCCO control panel with 120-volt disconnect switch	FP-2
NEPCCO control panel for VEP Skid 1	FP-3
NEPCCO control panel for VEP Skid 2	FP-4
Air/Water separator tank on VEP Skid 1	T-1
Water transfer pump in T-1	P-1
Light indicating status of P-1 (FP-3)	LT-101
Vacuum indicator on inlet of T-1	VI-101
Low level switch in T-1	LSL-101
High level switch in T-1	LSH-101
High-high level switch in T-1	LSHH-101
Pressure indicator on discharge of P-1	PI-101
Seal water recycle tank on VEP Skid 1	T-2
Low-low level switch in T-2	LSLL-102
Low level switch in T-2	LSL-102

Equipment/Instrumentation Item	Name
High level switch in T-2	LSH-102
High-high level switch in T-2	LSHH-102
Solenoid valve on city water line to T-2	SV-101
Light indicating status of SV-101 (FP-3)	LT-102
VEP Skid 1 level alarm light (FP-3)	LT-103
Vacuum pump on VEP Skid 1	VP-1
Vacuum indicator on VP-1 inlet	VI-102
Temperature element for VP-1	TE-101
Temperature indicator/alarm for VP-1	TIA-101
VP-1 high temperature alarm light (FP-3)	LT-104
Flow regulator in the line between T-2 and VP-1	FR-101
Light indicating Bio Treatment System Shutdown of VEP Skid 1 (FP-3)	LT-105
Air/water separator tank on VEP Skid 2	T-3
Water transfer pump in T-3	P-2
Light indicating status of P-2 (FP-4)	LT-201
Vacuum indicator on outlet of T-3	VI-201
Low level switch in T-3	LSL-201
High level switch in T-3	LSH-201
High-high level switch in T-3	LSHH-201
Seal water recycle tank on VEP Skid 2	T-4
Low-low level switch in T-4	LSLL-202
Low level switch in T-4	LSL-202
High level switch in T-4	LSH-202
High-high level switch in T-4	LSHH-202
Solenoid valve on city water line to T-4	SV-201
Light indicating status of SV-201 (FP-4)	LT-202
VEP Skid 2 level alarm light (FP-4)	LT-203
Vacuum pump on VEP Skid 2	VP-2
Vacuum indicator on VP-2 inlet	VI-202
Temperature element for VP-2	TE-201
Temperature indicator/alarm for VP-2	TIA-201
VP-2 high temperature alarm light (FP-4)	LT-204
Flow regulator in the line between T-4 and VP-2	FR-201
Light indicating Bio Treatment System Shutdown of VEP Skid 2 (FP-4)	LT-205

2.2.2 Operating Description

The two VEP systems operate in the same way. This section provides the basic operating philosophy of one VEP system.

Groundwater and soil vapors are drawn from the recovery wells through the use of a vacuum extraction pump and a vacuum header. The vacuum pump places a vacuum of 15-25 in. Hg on the air/water separator tank. The extraction piping from the wells is placed under vacuum by opening the isolation valves in the lines between the recovery wells and the air/water separator tank. Vapors are drawn off the top of the air/water separation tank into the vacuum pump and are discharged into the seal water recycle tank.

Water is transferred from the air/water separator tank to Biobed No. 1 by a submersible pump located in the tank. During normal operation, the selector switch for the transfer pump is placed in the "AUTO" position. The operation of the water transfer pump is controlled by level switches in the air/water separator tank. The operating status of the water transfer pump is indicated by a light on the NEPCCO field panel for that skid (FP-3 or FP-4). The discharge pressure of P-1 is displayed on a pressure indicator (PI-101) on the water line coming from T-1. There is no pressure indicator on the discharge of P-2.

Water from the seal water recycle tank is drawn by vacuum to the suction of the vacuum pump. The flow of seal water from the tank to the vacuum pump is regulated by a flow regulator located in the 1-inch seal water line. Water is bled from the seal water recycle tanks (T-2 and T-4) to the treatment building sump at a rate of approximately 0.5 gpm per tank. Makeup water is added to the seal water recycle tanks through city water lines connected to the tanks. The water is added automatically by the solenoid valves (SV-101 and SV-201). The solenoid valves are controlled by the high and low level switches in the seal water tanks when the selector switches for the solenoid valves (located on FP-3 and FP-4) are placed in the "AUTO" position. The hand valves (HV-107 and HV-207) on the line connecting the two seal water tanks are left open to equilibrate the temperatures of the two vacuum pumps in the event that one seal water tank is draining faster that the other.

During operation, the selector switches for the vacuum pumps (located on FP-1) are placed in the "AUTO" position. In "AUTO" mode, the vacuum pump will shut down if the water level reaches the high-high level probe in the air/water separator tank or the high-high or low-low probe in the seal water recycle tank on that skid. The vacuum pump will also shut down automatically if the temperature of the pump exceeds a high temperature set point (160°F). Both vacuum pumps will shut down if an alarm occurs with the biological treatment system.

The operating status of the water transfer pumps is indicated by lights on the NEPCCO field panels. Two level alarm lights on the field panels (one for each system) indicate whether a level-related alarm has occurred. Two high temperature alarm lights on the field panels indicate whether the temperature of the vacuum pumps has risen above 160°F and caused a shutdown. The temperature of each vacuum pump is displayed on a local digital temperature indicator on the VEP skids. Vacuum gauges are installed on the inlet of each vacuum pump, the inlet of T-1, and the vapor outlet of T-3.

2.2.3 Interlocks

The following is a list of the safety control and operational interlocks which govern the operation of the electrical equipment in the VEP systems:

Condition	Interlock
High-high level in T-1	- Stops VP-1, P-1 and closes SV-101
Low-low or high-high level in T-2	- Stops VP-1, P-1 and closes SV-101
High temperature at VP-1	- Stops VP-1, P-1 and closes SV-101
High/low level in T-1	- Starts/stops P-1
High/low level in T-2	- Closes/opens SV-101
High-high level in T-3	- Stops VP-2, P-2 and closes SV-201
Low-low or high-high level in T-4	- Stops VP-2, P-2 and closes SV-201
High temperature at VP-2	- Stops VP-2, P-2 and closes SV-201
High/low level in T-3	- Starts/stops P-2
High/low level in T-4	- Closes/opens SV-201
BTSS contacts close (CP-1)	- Stops VP-1, VP-2, P-1, P-2 and closes SV-101 and SV-201

2.2.4 Alarms

The following is a list of alarms associated with VEP systems. Each of the alarms listed below activates Alarm 1 on the autodialer in addition to illuminating the alarm light.

Condition

Alarm

High-high level in T-1 or T-2, or Low-low level in T-2	- VEP Skid 1 level alarm light LT-103 (FP-3)
High temperature at VP-1	- VP-1 high temp. alarm light LT-104 (FP-3)
High-high level in T-3 or T-4, or Low-low level in T-4	- VEP Skid 2 level alarm light LT-203 (FP-4)
High temperature at VP-1	- VP-2 high temp. alarm light LT-204 (FP-4)
BTSS shutdown contacts (CP-1)	- Bio Treatment System Shutdown alarm lights LT-105 (FP-3) and LT-205 (FP-4).

2.2.5 System Start-up

Start-up of VEP systems consists of the following step-by-step instructions:

- Close the following valves:
 - Drain valves on T-1 and T-3 (HV-106 and HV-206)
 - Drain valve on line connecting T-2 and T-4 (HV-112)
 - Valves on drain lines from T-2 and T-4 to the building sump (HV-108 and HV-208).
- Open the following valves:
 - Butterfly valve on the inlet to T-1 (HV-103)
 - Butterfly valve on the vapor outlet of T-3 ((HV-203)
 - Ball valve on the discharge line from P-1 (HV-105)
 - Gate valve on the discharge line from P-2 (HV-205)
 - Ball valve in the seal water line between T-2 and the inlet of VP-1 (HV-109)
 - Ball valve in the seal water line between T-4 and the inlet of VP-2 (HV-209)
 - Ball valves in the line between T-2 and T-4 (HV-107 and HV-207)
 - Valves on city water lines to T-2 and T-4 (HV-110, HV-111, HV-210).
- Verify that the seal water tanks are full; fill as needed (see Section 2.2.8).
- Start-up the biological treatment system (see Section 2.3.5).
- Place the selector switch for P-1 (on FP-3) in the "AUTO" position.

- Place the selector switch for P-2 (on FP-4) in the "AUTO" position.
- Place the selector switch for SV-101 (on FP-3) in the "AUTO" position.
- Place the selector switch for SV-201 (on FP-4) in the "AUTO" position.
- Place the selector switch for VP-1 (on FP-1) in the "AUTO" position.
- Place the selector switch for VP-2 (on FP-1) in the "AUTO" position.
- Set FR-101 and FR-201 to 8 gpm.
- Adjust the gate valves (HV-104 and HV-204) on the air vents on the VEP skids until the vacuum gauge on each vacuum pump suction line reads approximately 18-20 in. Hg.
- Open valves on drain lines from T-2 and T-4 to the building sump (HV-108 and HV-208) approximately 45 degrees.

2.2.6 System Shutdown

The VEP systems operate around the clock, 365 days a year. During normal operation, the VEP systems are shut down only for maintenance. The systems are shutdown by placing the selector switches for VP-1, VP-2, P-1, P-2, SV-101, and SV-201 in the "OFF" position. The tanks do not need to be drained unless work is being performed on the piping or the tanks.

2.2.7 Troubleshooting

A shutdown of one or both of the VEP systems is the most likely operational problem with the IGRTS. Should a VEP shutdown occur, the cause of the problem must be identified and corrected as soon as possible and the system must be restarted to ensure that all of the recovery wells remain balanced. The most probable cause of a shutdown of one of the VEP systems is a high-high liquid level in the air/water separator tank. This condition is most likely to occur during system start-up when the water recovery rate is highest. The most probable cause for this type of shutdown is that a large slug (i.e., large volume) of water enters the tank when the liquid level is very close to the high level switch, and activates the high-high level switch before the water transfer pump can lower the water level in the tank. Other possible causes include a problem with the water transfer pump, a tripped circuit breaker for the water transfer pump, or a problem with the level switch in the tank.

Should a high-high level in the air/water separator tank cause a shutdown, the following procedure should be followed to bring the system back on-line:

- The handswitch for the vacuum pump (on FP-1) should be placed in the "OFF" position.
- The drain valve on the seal water tank on the skid that shut down (HV-108 or HV-208) should be closed to allow the tank to fill with water.
- The "RESET" button on the NEPCCO field panel experiencing the alarm must be held in until the alarm condition goes away when the button is released. Holding the button down bypasses the interlock and allows the solenoid valve on the city water line to open and the water transfer pump to operate.
- When all the lights on the field panel experiencing the alarm are out and the "RESET" button is no longer held down, the skid is ready to be restarted. The handswitch for the vacuum pump (on FP-1) should be placed in the "AUTO" position.
- The operator should observe operation of the skid for 2-3 cycles of the water transfer pump to ensure that the condition will not reoccur. The hand valve on the air vent on the skid (HV-104 or HV-204) should be opened to decrease the vacuum on the system by approximately 1 in. Hg in the problem reoccurs.

If the water transfer pump does not appear to be operating properly, the circuit breaker for that pump should be manually turned off and then placed in the on position. This corrects the problem of a tripped breaker caused by loss of electricity to the panel. If the pump still does not operate, the circuit breaker or the pump may be faulty and must be tested and replaced if necessary.

A low-low liquid level in the seal water tank will also cause a level alarm shutdown of the VEP system. This condition could be caused by a fault with the city water line feeding the tank (including the solenoid valve), a problem with the level switch assembly in the tank, or having the drain valve on the tank set too far open.

The VEP system will also shut down on a high temperature alarm from the vacuum pump. This could be caused by process conditions that cause the vacuum pump to overheat or by a short in the thermocouple attached to the vacuum pump. Overheating of the vacuum pump could be caused by a shutdown of blower B-1 or any other situation that creates back

pressure on the seal water tanks. The operating status of B-1 and the valves in the vapor lines should be visually inspected to verify that all equipment is properly operating. Section 2.3.7 of the manual describes troubleshooting the blowers in the biological treatment system. Overheating of the vacuum pumps may also be caused by a loss of seal water. This can be avoided by increasing the flow of city water to the seal water recycle tank during summer when the ambient temperature in the building is at its highest.

2.2.8 Maintenance

The following is a list of recommended maintenance actions associated with the VEP systems:

- Monthly, inspect the piping on the VEP skids for leaks.
- Monthly, record the vacuum levels on the suction line to each vacuum pump (VI-101 and VI-201).
- Monthly, measure the air flow rates from T-2 and from T-4 and T-2 combined. Calculate the flowrate from T-4.
- Monthly, record the temperature of each vacuum pump.

2.3 Biological Treatment System

The biological treatment system consists of two blowers, three biological reactor tanks (the third was originally a fluidized activated carbon adsorber), an effluent holding tank and pump, and a nutrient feed tank and pump. This equipment is used to treat and discharge the liquid and vapor extracted by the VEP systems.

2.3.1 Equipment and Instrumentation Nomenclature

The hand valves in the IGRTS are labeled on the P&IDs. The following is a list of abbreviated names for the equipment and instrumentation included in this section:

Equipment/Instrumentation Item	Name
Biobed No. 1 (12,000-gallon biological reactor)	T-5
High-high level switch in T-5	LSHH-301
Light indicating high-high level in T-5 (CP-1)	LT-304
Blower feeding T-5	B-1
Light indicating the status of B-1 (CP-1)	LT-301

Equipment/Instrumentation Item	Name
Biobed No. 2 (1,200-gallon biological reactor)	T-6
High-high level switch in T-6	LSHH-302
Light indicating high-high level in T-6 (CP-1)	LT-305
Air flow element on inlet to T-6	FE-301
Blower feeding T-6	B-2
Light indicating the status of B-2 (CP-1)	LT-302
Pressure indicator of B-1 discharge	PI-301
Biobed No. 3 (1,200-gallon former fluidized activated carbon adsorber)	T-7
High-high level switch in T-7	LSHH-303
Light indicating high-high level in T-7 (CP-1)	LT-306
Air flow element on inlet of T-7	FE-302
Effluent holding tank	T-8
Low level switch in T-8	LSL-304
High level switch in T-8	LSH-304
High-high level switch in T-8	LSHH-304
Light indicating high-high level in T-8 (CP-1)	LT-307
Effluent transfer pump	P-3
Light indicating the status of P-3 (CP-1)	LT-303
Effluent water flow totalizer	FQ-301
Nutrient feed tank	T-9
Nutrient feed pump	P-5

2.3.2 Operating Description

Water is pumped from the air/water separator tanks (T-1 and T-2) to T-5 by the water transfer pumps (P-1 and P-2) on the vacuum extraction skids. The biological reactors contain random dump packing and filament packing covered with microorganisms that serve to biologically degrade the organic contaminants in the water. Blower B-1 draws the soil vapors from the seal water recycle tanks (T-2 and T-4) and discharges them into T-5. Ambient make-up air is added to the vapor stream through HV-302 at the suction of B-1. This ambient air is a source of oxygen for the microorganisms. The vapor stream enters T-5 at a point below the liquid level and is distributed in the tank via two headers running the length of the tank. The liquid and vapor streams travel counter-currently through T-5 in order to improve absorption of the organics into the water.

Blower B-2 transfers the vapors from T-5 to the bottom of T-6 and T-7. The stream is split such that the air flow rate to each tank is equal. The flow rates are balanced using the ball valves and variable area flow meters on the gas inlet lines to the tanks. Ambient make-up air is added to the vapor stream through HV-312 at the suction of B-2.

Water flows by gravity from the bottom of T-5 to the bottom of Biobed No. 2 (T-6). The water flows upward (with the vapor from B-2) through the filament packing containing the microorganisms in the tank. Water flows by gravity from T-6 to the bottom of Biobed No. 3 (originally a fluidized activated carbon bed [T-7]). The water from T-7 overflows into the effluent holding tank (T-8). The vapor streams from T-6 and T-7 are combined and discharged to the atmosphere outside the North wall of the treatment building.

During normal operation, the selector switch (at CP-1) for the effluent transfer pump (P-3) is set in the "AUTO" position. Operation of the pump is controlled by the high and low level switches in the T-8. The operating status of P-3 is indicated by a light on CP-1. The pump transfers water from T-8 to the storm sewer system. The effluent flow is totalized by an inline flow totalizer downstream of P-3.

If a high-high liquid level is detected in any of the tanks in the biological treatment system, if one of the blowers stops operating, or if the building sump high-high level switch is activated, the BTSS contacts in CP-1 are activated. High temperature switches on blowers B-1 and B-2 are integral to the motors, they do not show up on the wiring diagram for CP-1. Closure of the BTSS contacts signals NCP to shut down VP-1 and VP-2.

2.3.3 Interlocks

The following is a list of the safety control and operational interlocks which govern the operation of the electrical equipment in the biological treatment system:

Condition	<u>Interlock</u>
High temperature on B-1	- Stops B-1
High temperature on B-2	- Stops B-2
High/low level in T-8	- Starts/stops P-3

2.3.4 Alarms

Condition

The following is a list of alarms associated with the biological treatment system. All of the alarm lights listed are located on CP-1. Each of the alarms below activates Alarm 2 on the autodialer.

Alarm

Condition	<u> Marin</u>
High-high water level in T-5	- T-5 high-high level alarm light (LT-304)
High-high water level in T-6	- T-6 high-high level alarm light (LT-305)
High-high water level in T-7	- T-7 high-high level alarm light (LT-306)
High-high water level in T-8	- T-8 high-high level alarm light (LT-307)
High temperature on B-1	- B-1 fault alarm light (LT-308)
High temperature on B-2	- B-2 fault alarm light (LT-309)

2.3.5 System Start-up

Start-up of the biological treatment system consists of the following step-by-step instructions:

- Record the value on the flow totalizer and the time of system startup.
- Open the two 2-inch ball valves that vent ambient make-up air into the suction lines of blowers B-1 and B-2 (HV-302 and HV-312) approximately 45 degrees.
- Open the following valves:
 - Two 2-inch ball valves on the vapor inlets to T-5 (HV-304 and HV-305)
 - Four 2-inch ball valves on the vapor inlets to T-6 and T-7 (HV-318, HV-319, HV-322, and HV-323)
 - Two 2-inch ball valves that vent the discharge of blowers B-1 and B-2 into the treatment building (HV-303 and HV-315)
 - 1 1/2-inch ball valve between T-8 and P-3 (HV-325)
 - 2 1/2-inch ball valve on the water inlet to T-5 (HV-301)
 - 4-inch ball valve on the water outlet of T-5 (HV-309)

- Drain valves on the bottom of the demisters (HV-313 and HV-314).
- Close the following valves:
 - Drain valves on T-5 (HV-306, HV-307, and HV-308)
 - Drain valves on T-6 and T-7 (HV-311 and HV-324)
 - Isolation valves around air flow meters FE-301 and FE-302 (HV-316, HV-317, HV-320, and HV-321)
 - Sample valve on P-3 discharge (HV-326)
- Place the handswitch for P-3 in the "AUTO" position.
- Place the handswitch for B-1 in the "AUTO" position.
- Place the handswitch for B-2 in the "AUTO" position.
- Slowly close vent valve HV-303 on the discharge of B-1 until the valve is totally closed.
- Slowly close vent valve HV-315 on the discharge of B-2 until the valve is totally closed.
- Start the extraction system (see Sections 2.2.5 and 2.1.5)
- Plug the cord for the nutrient feed pump into an electrical outlet.

2.3.6 System Shutdown

The biological treatment system operates around the clock, 365 days a year. During normal operation, the system is shut down only for maintenance. The following are step-by-step instructions for shutdown of the biological treatment system:

- Unplug the nutrient feed pump (P-5).
- Shut down the extraction system (see Sections 2.1.6 and 2.2.6).
- Leave the handswitches for B-1 and B-2 in the "ON" position at all times unless work is being performed on the blowers or in the bio reactors; even if the VEP systems are shut down. This ensures that the microorganisms in the reactors have sufficient oxygen.

- Leave handswitch for P-3 in the "AUTO" position at all times unless work is being performed on the effluent tank or pump; make sure that water has stopped flowing through system before turning pump "OFF".
- Open the 2-inch ball valves that vent the discharge of blowers B-1 and B-2 into the treatment building (HV-303 and HV-315)

2.3.7 Troubleshooting

In the event that the concentration of VOCs in the effluent water or vapors begins to increase, this may indicate a problem with the microorganism population in the reactors. Richards Laboratories (the supplier of the biological treatment system) should be contacted immediately to diagnose the problem and correct it.

In the event that one of the blowers in the biological treatment system or the effluent pump is malfunctioning, the VEP systems should be shut down and the unit should be repaired. The manufacturers' literature provided in Appendix C gives details on the maintenance that can be performed by the system operator. If the problem persists after following the directions in the manufacturers' literature, the vendor that supplied the unit should be contacted to provide repairs.

If persistent high-high level alarms occur in one of the tanks in the biological treatment system, the level switch should be visually inspected and manually tested for proper operation. A defective level switch must be replaced as soon as possible. The IGRTS should not be operated until the faulty switch is replaced.

If foam appears in the effluent tank or begins to come out the air vent outside the building, this is a symptom of the microorganisms going into anaerobic (lacking oxygen) conditions. The ambient air bleed valves on the blower suction lines should be checked for proper positioning. If the condition persists, Richards Laboratories should be contacted immediately to diagnose the problem and correct it.

In the event that the level in the nutrient feed tank (T-9) is not dropping over time, the system is not getting the proper amount of nutrients. The nutrient feed pump (P-5) and the check valve at the point where the nutrient feed line ties into the water line to T-5 should be

checked to ensure that they are not plugged and are functioning properly. Appendix C-6 contains vendor literature for the nutrient feed pump.

In the event of a problem or to order nutrient mix, Richards Laboratories can be contacted at:

Dean Richards or Robert Richards Richards Laboratories 55 East Center Pleasant Grove, UT 84062 (800) 453-1210 or (801) 785-2500

2.3.8 Maintenance

The following is a list of recommended maintenance actions associated with the biological treatment system:

- Monthly or as needed, add nutrient mix to tank T-9 and add water to make up solution. One 5-gallon bucket of mix must be added to 150 gallons of fresh water, therefore, the tank should be almost empty before more solution is made up. The nutrient mix is ordered from Richards Laboratories at the address given in Section 2.3.7.
- Monthly, inspect the piping for leaks.
- Monthly, measure and record the air flow rates to T-6 and T-7 and the discharge out the building.
- Monthly (or with every visit), record the number on the flow totalizer and the date and time of the recording.

3.0 System Control

3.1 Power Panels and Transformer

Power is supplied to the site behind the control shed. The electric meter and main transformer are located here. A 480-volt, three-phase feeder runs into the main power panel (PP-1). There are three circuits used in PP-1: 60-amp/three-phase to FP-2 for the vacuum pumps; 60-amp/three-phase to CP-1 for the blowers, and 60-amp/ single-phase to the transformer TR-1. The panel also has two spare 40-amp circuits and a blank space for a sixth circuit breaker.

Transformer TR-1 is a 45 kVA delta-type transformer that supplies the 120-volt power for the site. The 120-volt power from the transformer runs into power panel PP-2. This panel contains the circuit breakers for the lighting, power receptacles, heat tracing circuits, building heater, and 120-volt power to CP-1 and FP-2. The circuits are labeled on the inside of the door of PP-2.

3.2 Control Panels

The system is controlled by a set of field panels and a main control panel, all located in the control shed. Field panels FP-1 through FP-4 are mounted on a steel frame on the inside North wall of the shed. These panels control the two VEP skids. Field panel FP-1 contains a 480-volt disconnect switch and the OFF/AUTO handswitches for the vacuum pumps. The starters for the vacuum pumps are located inside FP-1. Field panel FP-2 contains the 120-volt disconnect switch for the VEP skids. Power from this panel feeds field panels FP-3 and FP-4. Field panel FP-3 contains the control relays and breaker switches for the 120-volt equipment and the instruments on VEP Skid 1. The face of FP-3 contains the handswitches for the water transfer pump in T-1 and the solenoid valve on the city water feed line to T-2. Field panel FP-4 contains the same controls as FP-3 for VEP Skid 2.

The main control panel (CP-1) contains all the controls and starters for the equipment in the biotreatment system and the building sump pump. Control panel CP-1 also contains the autodialer that is programmed to alert the operator of system shutdowns via telephone. Interconnecting wiring between CP-1 and the field panels enables CP-1 to shut down the VEP systems in the event of a problem with the biotreatment system and to initiate operation of the autodialer in the event of a problem with one or both of the VEP systems. Wiring diagrams and instrument specifications for the control panels are included in Appendix C of this manual.

3.3 Autodialer

Operation of the IGRTS at the Naples Truck Stop site is semiautomatic. Normal operation consists of placing the system on line and allowing it to operate continuously, with periodic monitoring and adjustments. When an alarm condition arises, the system notifies the operator by activating the autodialer located in CP-1 which calls a series of pre-programmed phone numbers and leaves a numeric message of all "9's" or plays a prerecorded message related to the alarm condition.

The autodialer used in this system is a Verbatim made by Raco. This manual should be consulted prior to altering any of the settings on the autodialer. The autodialer phone number is (801) 781-2139. A manual for the autodialer is provided in Appendix C-4. This manual gives detailed instructions on use of the autodialer, including how to record messages on the autodialer and how to set the phone numbers to be called. The numbers are called in order, one every 15 minutes, until the alarm is acknowledged. At the time of start-up, the following phone numbers for Jacobs Engineering (the firm contracted to operate the IGRTS) and Kleinfelder (their local subcontractor) were programmed into the autodialer:

Call	Telephone		
<u>No.</u>	<u>Number</u>	Digits Entered	Call Placed To:
01	801-646-1670	18016461670*69999*8*5	Vernal Pager
02	800-616-8589	18006168589#9#9#99#99*8*5	Kleinfelder Pager
03	800-616-8589	18006168589#9#9#99#99*8*5	Kleinfelder Pager
04	800-616-8589	18006168589#9#9#99#99*8*5	Kleinfelder Pager
05	800-616-8587	18006168587#9#9#99#99*8*5	Jacobs Engineering Pager
06	800-616-8587	18006168587#9#9#99#99*8*5	Jacobs Engineering Pager
07	800-616-8587	18006168587#9#9#99#99*8*5	Jacobs Engineering Pager
08	801-486-9256	18014869256	Matt Crockett Home
09	916-649-1242	19166491242	Dayton Busch Home
10	510-669-9897	15106699897	Brian Keating Home
11	916-568-4714	19165684714	Jacobs Engineering Office

The telephone numbers above reflect the following sequence of calls:

- The first call is placed to the local pager. If an operator is in the Vernal area they will receive the numeric message "9999" on the pager immediately after an alarm occurs.
- Fifteen minutes after the local pager is called and if no acknowledgement is received, the autodialer calls the PageNet number for the Kleinfelder pager. The pager will receive the numeric message consisting of a string of 9's. This number is tried three times with 15-minute intervals in between each call.
- Fifteen minutes after the third call is made to the Kleinfelder pager and if no acknowledgement has been received, the autodialer calls the PageNet number for the Jacobs Engineering pager. The pager will receive the numeric message

consisting of a string of 9's. This number is tried three times with 15-minute intervals in between each call.

• Fifteen minutes after the third call is made to the Jacobs pager and if no acknowledgement has been received, the autodialer calls the home numbers of the Kleinfelder field technician (Matt Crockett), the Jacobs Engineering field technician (Dayton Busch), the Jacobs Engineering project manager (Brian Keating), and the Jacobs Engineering office number, in that order. The autodialer will leave a spoken message regarding the cause of the alarm (see below). If the alarm remains unacknowledged, the autodialer starts with programmed telephone number 01.

When the operator receives a numeric message consisting of only the digit "9", they should call the autodialer at 801-781-2139 as soon as possible to acknowledge the alarm and stop the call out procedure. In the event that a person receives an alarm call from the autodialer, the person who receives the call must press the "9" button on the phone at the sound of the tone, or call the autodialer back at the above number to acknowledge the alarm. After the alarm has been acknowledged, the autodialer will not call again for six hours for the alarm condition that was acknowledged (it may call for other alarms). If the condition is corrected during this time, the autodialer will not place another call. If the alarm condition still exists after six hours, the autodialer will begin the call-out procedure again.

3.3.1 Alarm One Information

The following is a summary of information regarding Alarm 1 on the autodialer:

Message: "One or both of the vacuum extraction systems has shut down."

Meaning of the message: One or more of the five alarms associated with the VEP

control panels have been activated. This could have been caused by any of the following eight switches being tripped: The high-high level switch on T-1, T-2, T-3, or T-4; the low-low level switch on T-2 or T-4; the high temperature switch on VP-1 or VP-2. It could also be activated by the BTSS contacts being closed in CP-1.

Interlocks: When one of the VEP skids shuts down, the vacuum pump and water transfer pump on that skid stop and the

solenoid valve on the city water line to that skid closes.

Possible cause No. 1: Water is entering T-1 at a higher rate than it can be

pumped out by P-1 (VEP Skid 1 shutdown).

Possible cause No. 2: Water is entering T-3 at a higher rate than it can be

pumped out by P-2 (VEP Skid 2 shutdown).

Possible cause No. 3: The water level in seal water tank T-2 is too low (VEP

Skid 1 shutdown).

Possible cause No. 4: The water level in seal water tank T-4 is too low (VEP

Skid 2 shutdown).

Possible cause No. 5: VP-1 or VP-2 is not operating properly, causing it to

overheat (VEP Skid 1 or VEP Skid 2 shutdown).

Possible cause No. 6: An alarm condition has arisen in the biological treatment

system (VEP Skid 1 and Skid 2 shutdown). Note: this will also activate Alarm 2 on the autodialer, see below.

3.3.2 Alarm Two Information

The following is a summary of information regarding Alarm 2 on the autodialer:

Message: "A high-high liquid level or blower shutdown has

occurred in the biological treatment system."

Meaning of the message: One of five high-high level switches has been tripped, or

either of the two blowers in the biological treatment system has shut down. The five level switches associated with this alarm are located in T-5, T-6, T-7, T-8, and the building sump. Note: if a message for Alarm 2 is

received, a message for Alarm 1 will also be received.

Interlocks: Any of the alarm conditions above shut down VEP Skid 1

and VEP Skid 2.

Possible cause No. 1: The gravity discharge in one of the biological treatment

tanks (T-5, T-6, or T-7) is being obstructed.

Possible cause No. 2: Foam in one of the bioreactors may be accumulating or

the plastic mesh in the tank may be rising and lifting the

high-high level switch in that tank.

Possible cause No. 3: Water is entering the building sump at a higher rate than

can be pumped by P-4, either because P-4 is not operating properly, or because the building is in a flood condition.

Possible cause No. 4: Blower B-1 or B-2 has shut down due to a high

temperature alarm (probably due to blockage of the

discharge line) or an electrical fault.

3.3.3 Alarm Three Information

The following is a summary of information regarding Alarm 3 on the autodialer:

Message: "A high-high liquid level has occurred in the treatment

building sump"

Meaning of the message: A building flood condition may be occurring. Note: if a

message for Alarm 3 is received, messages for Alarms 1

and 2 will also be received.

Interlocks: This alarm condition shuts down VEP Skid 1 and VEP

Skid 2.

Possible cause No. 1: Pump P-4 is not operating properly.

Possible cause No. 2: There is a leak in the process piping or a tank, or water is

overflowing from one of the tanks, causing a flooded

condition in the treatment building.

3.3.4 Alarm Four Information

The fourth alarm on the autodialer is not being used at this time. It can be used to facilitate system expansion or reconfiguration.

4.0 Sampling and Analysis

Sampling and analysis requirements for the Naples Truck Stop IGRTS are based on the discharge requirements of the Ashley Valley Water and Sewer Improvement District and the Utah Department of Air Quality. The sampling schedule prepared by Jacobs Engineering includes samples required by these agencies as well as those required to evaluate system performance.

Table 1 shows the original sampling and analysis schedule prepared by Jacobs Engineering. This schedule shall be modified as needed throughout the operation period to address site requirements. Appendix B contains a form to be completed by the operator to keep track of the sampling and analysis requirements.

TABLES

Table 1 **Sampling and Analysis Schedule** Interim Groundwater Recovery and Treatment System Naples Truck Stop Naples, Utah

First Two Months of Operation

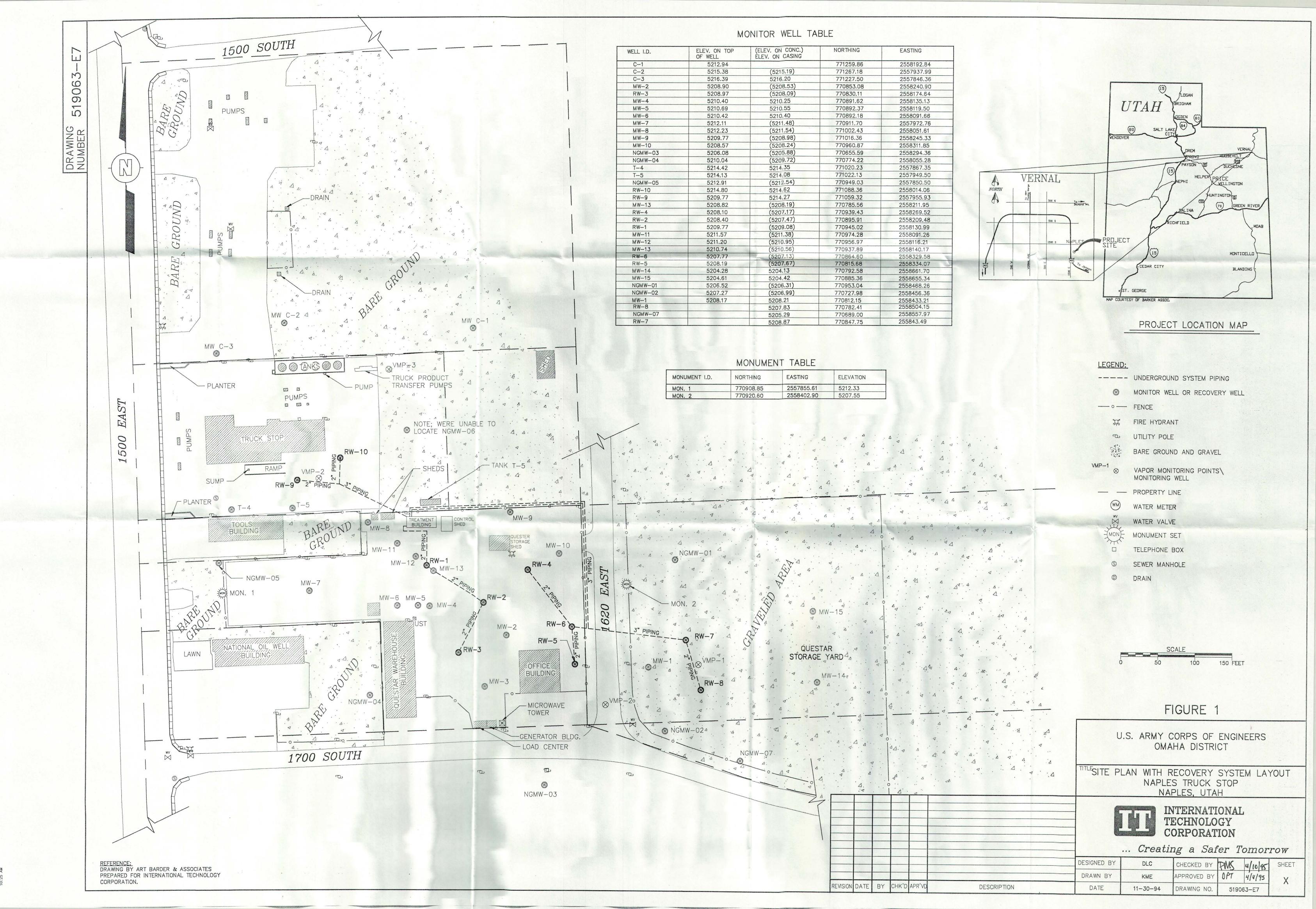
Total Quantity for 2 Months	Matrix	Sample Location	Parameter	Test Method
8	Water	Effluent to POTW	Gasoline/BTEX	Mod 8015
8	Water	Water influent to Biobed No. 1	Gasoline/BTEX	Mod 801/5
8	Water	Water effluent to Biobed No. 1	Gasoline/BTEX	Mod 8015
2	Gas	Vapor influent to Biobed No. 1	втех	TO14 (Summa cannister)
2	Gas	Vapor effluent from Biobed No. 1	втех	TO 14 (Summa cannister)
2	Gas	Vapor effluent to atmosphere	BTEX	TO14 (Summa cannister)
30	Water	Groundwater monitoring wells (15 wells)	Gasoline/BTEX	Mod 8015
12	Gas	Vapor monitoring wells (6 wells)	втех	TO14 (Summa cannister)
	Quantity for 2 Months 8 8 2 2 2 30	Quantity for 2 Matrix 8 Water 8 Water 2 Gas 2 Gas 30 Water	Quantity for 2 MonthsMatrixSample Location8WaterEffluent to POTW8WaterWater influent to Biobed No. 12GasVapor influent to Biobed No. 12GasVapor effluent from Biobed No. 12GasVapor effluent to atmosphere30WaterGroundwater monitoring wells (15 wells)12GasVapor monitoring wells	Quantity for 2 MonthsMatrixSample LocationParameter8WaterEffluent to POTWGasoline/BTEX8WaterWater influent to Biobed No. 1Gasoline/BTEX8WaterWater effluent to Biobed No. 1Gasoline/BTEX2GasVapor influent to Biobed No. 1BTEX2GasVapor effluent from Biobed No. 1BTEX2GasVapor effluent to atmosphereBTEX30WaterGroundwater monitoring wells (15 wells)Gasoline/BTEX12GasVapor monitoring wellsBTEX

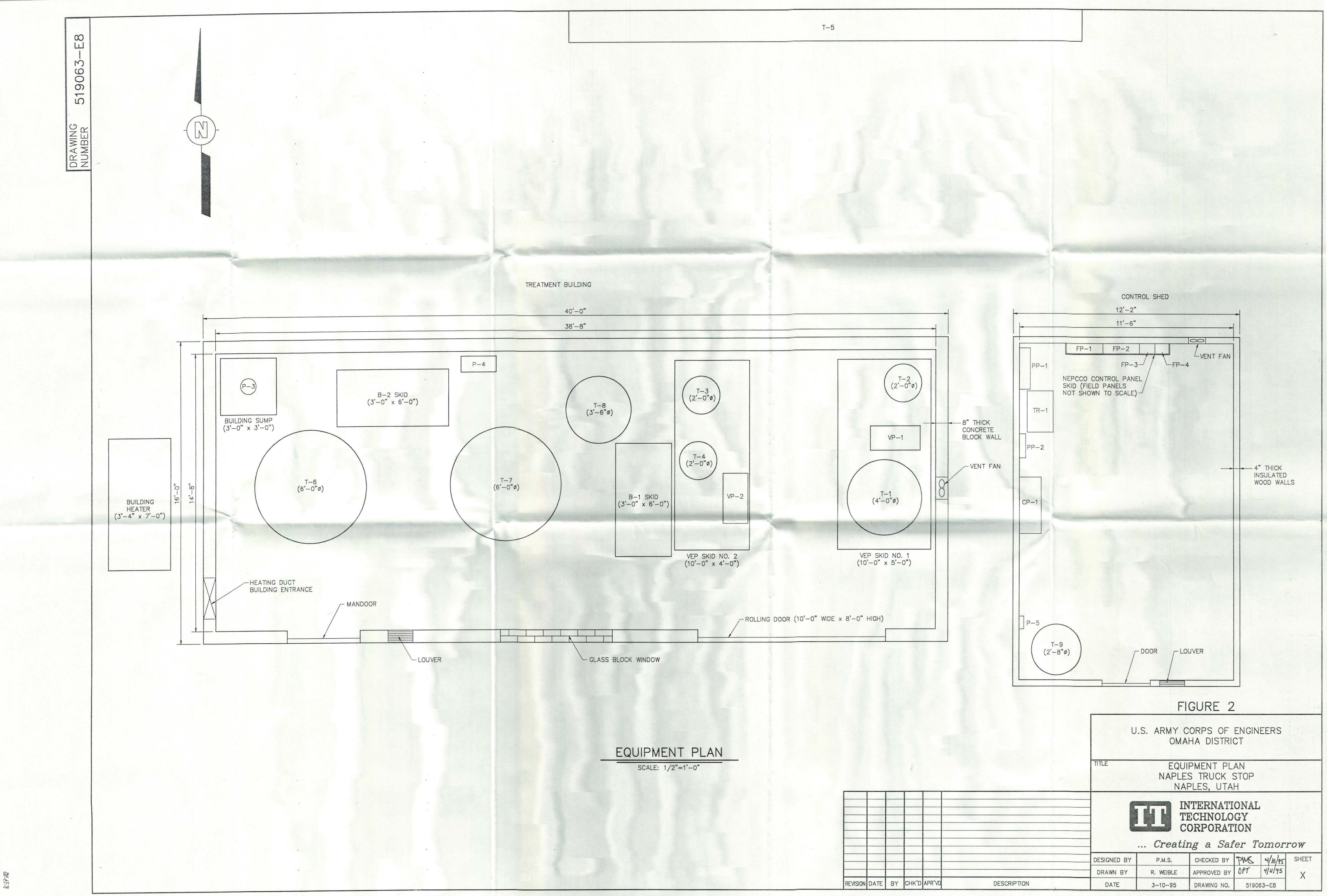
Table 1 (continued)

10 Month Period Following First Two Months of Operation

Total Quantity for 10 Months	Matrix	Sample Location	Parameter	Test Method
10	Water	Effluent to POTW	Gasoline/BTEX	Mod 8015
5	Water	Water influent to Biobed No. 1	Gasoline/BTEX	Mod 8015
5	Water	Water effluent from Biobed No. 1	Gasoline/BTEX	Mod 8015
5	Gas	Vapor influent to Biobed No. 1	ВТЕХ	TO 14 (Summa cannister)
5	Gas	Vapor effluent from Biobed No. 1	BTEX	TO 14 (Summa cannister)
5	Gas	Vapor effluent to atmosphere	BTEX	TO 14 (Summa cannister)
150	Water	Groundwater monitoring wells (15 wells)	Gasoline/BTEX	Mod 8015
60	Gas	Vapor monitoring wells (6 wells)	BTEX	TO 14 (Summa cannister)
	Quantity for 10 Months 10 5 5 5 5 150	Quantity for 10 Matrix 10 Water 5 Water 5 Gas 5 Gas 150 Water	Quantity for 10 MonthsMatrix MatrixSample Location10WaterEffluent to POTW5WaterWater influent to Biobed No. 15WaterWater effluent from Biobed No. 15GasVapor influent to Biobed No. 15GasVapor effluent from Biobed No. 15GasVapor effluent to atmosphere150WaterGroundwater monitoring wells (15 wells)60GasVapor monitoring wells	Quantity for 10 MonthsMatrixSample LocationParameter10WaterEffluent to POTWGasoline/BTEX5WaterWater influent to Biobed No. 1Gasoline/BTEX5WaterWater effluent from Biobed No. 1Gasoline/BTEX5GasVapor influent to Biobed No. 1BTEX5GasVapor effluent from Biobed No. 1BTEX5GasVapor effluent to atmosphereBTEX150WaterGroundwater monitoring wells (15 wells)Gasoline/BTEX60GasVapor monitoring wellsBTEX

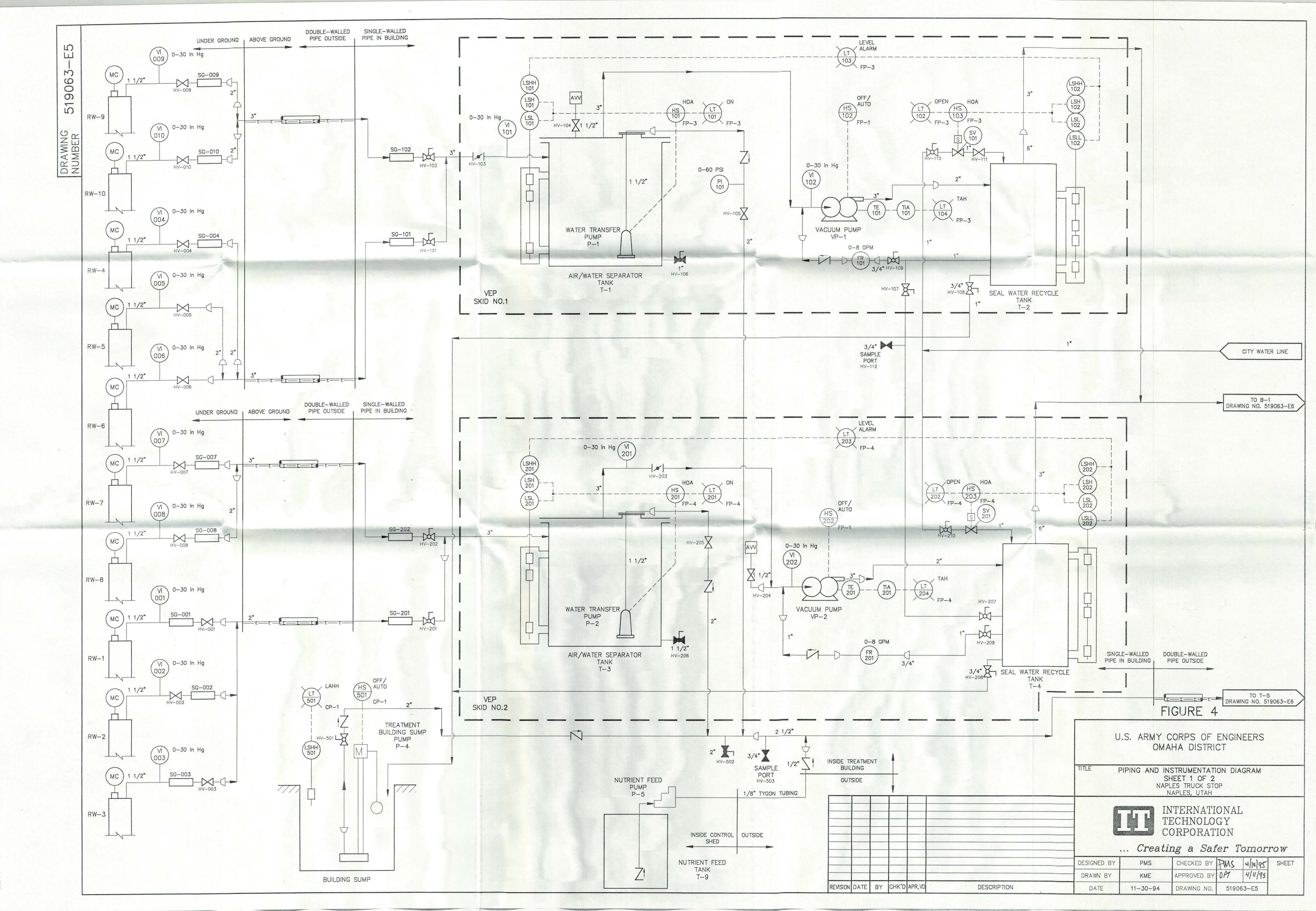
FIGURES

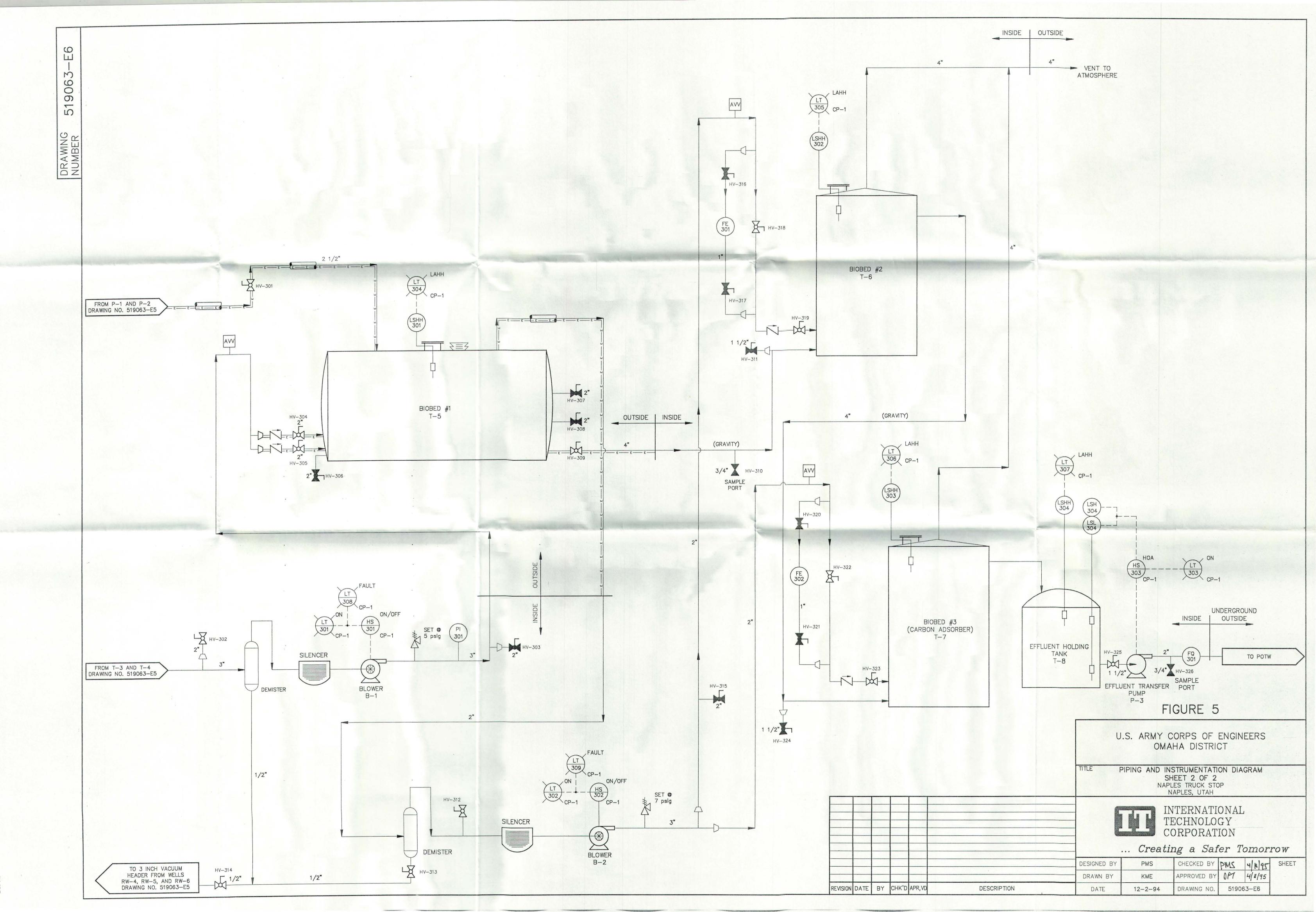




INSTRUMENT ABBREVIATIONS	INSTRUMENT SYMBOLS	GENERAL EQUIPMENT	MANUALLY OPERATED VALVES	LINE & PIPING SYMBOLS IDENTIFICATION	MISCELLANEOUS
CP-1 CONTROL PANEL NO. 1 FE FLOW ELEMENT (VARIABLE AREA METER) FP-1 NEPCCO FIELD PANEL NO. 2 FP-3 NEPCCO FIELD PANEL NO. 3 FP-4 NEPCCO FIELD PANEL NO. 4 FQ FLOW TOTALIZER FR FLOW REGULATOR HOA HAND/OFF/AUTOMATIC HS HAND SWITCH HV-XXX HAND VALVE NO. XXX LAHH LEVEL ALARM, HIGH-HIGH LSH LEVEL SWITCH, HIGH-HIGH LSH LEVEL SWITCH, HIGH LSL LEVEL SWITCH, LOW LSLL LEVEL SWITCH, LOW LSLL LEVEL SWITCH, LOW LSLL LEVEL SWITCH, LOW PI PRESSURE INDICATOR SG SIGHT GLASS SV SOLENOID VALVE TAH TEMPERATURE ELEMENT (THERMOCOUPLE)	LIGHT LOCAL MOUNTED INSTRUMENT INSTRUMENT MOUNTED ON CONTROL PANEL (WHERE XXX IS CONTROL PANEL DESIGNATION) PRESSURE RELIEF VALVE LS FLOAT-TYPE LEVEL SWITCH	CENTRIFUGAL PUMP METERING PUMP VERTICAL SUMP PUMP WITH MECHANICAL FLOAT SWITCH ROTARY LUBE BLOWER VACUUM PUMP SUBMERSIBLE PUMP	BALL VALVE (OPEN) BALL VALVE (CLOSED) BUTTERFLY VALVE CHECK VALVE GATE VALVE GLOBE VALVE SOLENOID VALVE	PROCESS LINE ELECTRICAL SIGNAL INSULATED LINE ELECTRICALLY TRACED AND INSULATED LINE	AVV AIR VENT/VACCUUM BREAKER TANK INSULATION MC MANOMETER CONNECTION
TI TEMPERATURE INDICATOR VI VACUUM INDICATOR					
			REVISION DATE BY	DESIGNE DRAWN	BY KME APPROVED BY DPT 4/11/95

0/95





APPENDICES

APPENDIX A POTW Discharge Permit

ASHLEY VALLEY WATER AND SEWER IMPROVEMENT DISTRICT

1344 West Highway 40 • P.O. Box 987 • Vernal, Utah 84078 Telephone: (801) 789-9400

January 17, 1995

I T CORPORATION

Attn: Ken Hartinez

The I T Corporation can begin discharge into the Ashley Valley District sewer lines, based on the test results already received by the District, and also based on the 'company' complying with the Ashley Valley Districts Sewer Ordinance, and completing the monthly BTex tests.

Sincerely.

Boyd Workman District Manager

BW/da

Enc/Ordinance

APPENDIX B
Log Sheets



OPERATION OF SHEET INTERIM GROUNDWATER RECOVERY AND TREATMENT SYSTEM NAPLES TRUCK STOP NAPLES, UTAH

Date					, <u>12 m - 17 77 - 17 - 17 - 17 - 17 - 17 - 17</u>		
Time							
Eff. Water Flow Total	(Gal.)						
Vacuum on Well Lines					 		•••
RW-1 (VI-001)	(in. Hg)						
RW-2 (VI-002)	(in. Hg)						
RW-3 (VI-003)	(in. Hg)	•					
RW-4 (VI-004)	(in. Hg)				 		
RW-5 (VI-005)	(in. Hg)		·			_	
RW-6 (VI-006)	(in. Hg)						
RW-7 (VI-007)	(in. Hg)						
RW-8 (VI-008)	(in. Hg)						
RW-9 (VI-009)	(in. Hg)						
RW-10 (VI-010)	(in. Hg)						
Vacuum on Well Casings					 	•••	
RW-1	(in. H ₂ 0)						
RW-2	(in. H ₂ 0)						
RW-3	(in. H ₂ 0)						
ŘŴ-4	(in. H ₂ 0)						
RW-5	(in. H ₂ 0)				 		
RW-6	(in. H ₂ 0)			,		-	
RW-7	(in. H ₂ 0)						
RW-8	(in. H ₂ 0)	A SPECIAL DE LA CONTRACTOR DE LA CONTRAC					
RW-9	(in. H ₂ 0)	101 - HALL - 180 - 180 - 170 - 180 -			 		
RW-10	(in. H ₂ 0)						70.13
VP-1 Vacuum (VI-101)	(in. Hg)						
VP-2 Vacuum (VI-201)	(in. Hg)						
B-1 Inlet Velocity	(ft/s)				 		
VP-1 Oultet Velocity	(ft/s)						
VP-2 Calc. Velocity	(ft/s)				 		
Eff. Gas Velocity	(ft/s)						
Air Flow to T-6 & T-7	(ft/s)						
Temp. of VP-1	(deg F)	· · · · · · · · · · · · · · · · · · ·	<u> </u>				
Temp. of VP-2	(deg F)				 		
Building Temperature	(deg F)				 		

Page:	1	
ı uyu.		

SAMPLE LOG SHEET INTERIM GROUNDWATER RECOVERY AND TREATMENT SYSTEM NAPLES TRUCK STOP NAPLES, UTAH

Date	Time	Sample Location	Lab Performing Analysis	Analysis Parameters	Turnaround	Results
						2. 2
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		*** <u>*************</u>	<u> </u>			· · · · · · · · · · · · · · · · · · ·

APPENDIX C Manufacturers' Literature

APPENDIX C-1 NEPCCO Vacuum Enhanced Pumping Systems



2140-100 N.E. 36th Ave., Ocala, FL 34470 (904) 867-7482 • Fax: (904) 867-1320

Welcome!

Thank you for choosing NEPCCO as your equipment supplier. At NEPCCO, we are committed to developing outstanding products that are easy to use; our goal is to significantly enhance your productivity.

We are equally committed to providing you with the highest standard of service and support after you have purchased a NEPCCO product. We believe that the quality of our support and customer service is as important as the quality of our products.

Please don't hesitate to let me know how we are doing. It is through your comments and suggestions that we learn how we can continue to improve our products and services. Our toll free Customer Support No. is 800-277-3279.

We value you as a customer, and we want you to be as pleased with your NEPCCO product as we are in bringing it to you.

Sincerely,

Michael R. Studer

Quality Assurance Manager

hilde Son



Standard Equipment Limited Warranty

- (a) NEPCCO Equipment, a Division of International Technology Corporation, warrants that any Equipment which it manufactures will be free from substantial defects in material and workmanship for a period of one (1) year from the date such goods are delivered to a carrier by NEPCCO for shipment to the Customer.
- (b) The Customer agrees that the liability of NEPCCO hereunder shall be limited to replacing, repairing, or issuing credit for, at NEPCCO's discretion, any Equipment which is returned FOB NEPCCO's plant within the applicable term of the warranty, provided that (i) upon examination of the Equipment NEPCCO determines that the alleged defect constitutes a substantial defect, and (ii) the warranty made herein is not invalid pursuant to Section (d) hereof. The Customer agrees that such replacement, repair, or credit shall be its sole and exclusive remedies hereunder. For purposes hereof, a substantial defect shall mean any defect which prevents the Equipment from operation in accordance with NEPCCO's published specifications. In the event that NEPCCO determines that Equipment which is no longer manufactured by it contains a substantial defect and the warranty covering the defective equipment is not invalid pursuant to Section (d) hereof, the Customer's sole and exclusive remedy hereunder shall be the repair of such Equipment or the replacement of such Equipment with new equipment at NEPCCO's discretion. In no case is Equipment to be returned by the Customer without first obtaining a Return Material Authorization number form NEPCCO. Equipment which is repaired or replaced pursuant to this warranty shall continue to be warranted for the unexpired portion of the warranty term applicable to the Equipment so repaired or replaced. NEPCCO shall make the final determination as to the existence or cause of any alleged defect.
- (c) The foregoing warranty shall not be valid (i) if the alleged defect is the result of abuse, misuse, accident, alteration, neglect, or unauthorized repair: (ii) if NEPCCO requires installation of Equipment by specifically approved NEPCCO employee and such installation is not effected, or the Equipment is otherwise installed improperly. Any repair shall be deemed unauthorized unless it is made (i) by NEPCCO or a duly authorized agent or NEPCCO or (ii) with the written consent of NEPCCO.
- (d) The operating performance of treatment, abatement and recovery Equipment and systems is affected by factors unrelated to their manufacture, including operating environment and such conditions of use as contaminant and related substance build-up, the frequency and type of operator maintenance and other external variables. For these reasons, specific levels of performance cannot be guaranteed for such Equipment and systems.
- (e) THIS WARRANTY IS THE SOLE WARRANTY MADE BY NEPCCO TO THE CUSTOMER AND IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS, EXPRESSED OR IMPLIED. NEPCCO EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
- (f) THE CUSTOMER AGREES THAT IN NO EVENT SHALL NEPCCO BE LIABLE FOR SPECIAL, INCIDENTAL, INDIRECT, EXEMPLARY OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR ANY OTHER ECONOMIC LOSS. WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY.
- (g) THE REMEDIES PROVIDED HEREIN ARE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES.

START UP PROCEDURES ENGINEERING DRAWINGS COMPONENTS LISTS

VACUUM PUMP 2

CONTROL PANELS

TRANSFER PUMPS 4

INSTRUMENTATION 5

MAINTENANCE & TROUBLESHOOTING 6

SECTION 1

START-UP PROCEDURES ENGINEERING DRAWINGS COMPONENTS LISTS

SYSTEM ACCEPTANCE PROCEDURE

JOB NUMBER: 729008 EH	CUSTOMER:	IT/PITTS	BURGH
CATEGORY	ACCEPTED DO NOT CHECK		
1.0 SYSTEM DESIGN 1.1 PROCESS FLOW PER P&ID	CONTROL	-38K 	4/2/94
2.0 PHYSICAL 2.1ADEQUATE BRACES INSTALLED. 2.2 PIPING ORIENTATION CORRECT. 2.3 SKID PERIMETER CLEAR 2.4 TOWER & SUMP ALIGNMENT MARKS. 2.5 TOUCH UP PAINT COMPLETE. 2.6 NAMEPLATE ATTACHED. 2.7 SERIAL NUMBER STAMPED ON SKID. 2.8 SERIAL NUMBERS RECORDED.	CONTROL		-6/2/94
3.0 SYSTEM FINAL TEST 3.1 ELECTRICAL POWER AND CONTROLS PER P&ID 3.2 INSTRUMENTATION OPERATING RANGE CORRECT 3.3 MOTOR ROTATION/MECH MOVEMENT CORRECT 3.4 ALL CONTROLS FUNCTION CORRECTLY 3.5 SYSTEM SHUTDOWN VIA EACH FAILSAFE SENSOR 3.6 PUMP CONTROLLERS CYCLING PUMPS CORRECTLY 3.7 ALL INSTRUMENTATION FUNCTIONS CORRECTLY 3.8 FAILSAFE SENSORS RECONNECTED AFTER TEST	NET 7 CUALITY		42/99
COMMENTS:			

SYSTEM ACCEPTANCE PROCEDURE

JOB NUMBER:	CUSTOMER:	שצדווק/דו	URGH
CATEGORY	ACCEPTED DO NOT CHECK	INITIALS OFF UNTIL COM	
1.0 SYSTEM DESIGN 1.1 PROCESS FLOW PER P&ID	CONTROL	BBK BBK	9/27/94
2.0 PHYSICAL 2.1ADEQUATE BRACES INSTALLED	CONTROL		9/29/94
3.0 SYSTEM FINAL TEST 3.1 ELECTRICAL POWER AND CONTROLS PER P&ID 3.2 INSTRUMENTATION OPERATING RANGE CORRECT 3.3 MOTOR ROTATION/MECH MOVEMENT CORRECT 3.4 ALL CONTROLS FUNCTION CORRECTLY	CONTROL	33X 33X	9/29/94
			

UNLOADING PROCEDURE FOR NEPCCO SKID MOUNTED EQUIPMENT

BEFORE ATTEMPTING TO UNLOAD ANY EQUIPMENT, ENSURE THAT NO DAMAGE HAS OCCURRED DURING SHIPMENT.

FORKLIFT

NOTE: NEPCCO DOES NOT RECOMMEND THAT SYSTEMS OF EXCESSIVE WEIGHT OR SIZE (LARGER THAN 6' X 12') OR CONTAINERIZED SYSTEMS (BUILDINGS) BE UNLOADED WITH A FORKLIFT. FORKLIFT SLOTS ON 8' X 16' AND 10' X 20' SKIDS ARE INTENDED ONLY FOR MOVING THE SKID AT THE NEPCCO FACTORY.

- 1) Verify that all shipping restraints have been removed.
- 2) Allow forks to enter the fork slots as far as possible.
- 3) Lift the skid and tilt as necessary to clear trailer bed.
- 4) Back away from trailer until the unit is clear, then lower the unit for transportation.
- 5) Set skid into place and withdraw forks from fork slots.

CRANE

- 1) Verify that all shipping restraints have been removed.
- 2) Containerized units (buildings), as well as many skid mounted systems, require the use of cable spreader bars when unloading with a crane. The distance between the spreader bar eyes should be a minimum of 12'.

- 3) The cables attaching the spreader bars to the skid lifting eyes should be a minimum of 12', and should be secured at each connection point with a clevis of appropriate rating.
- 4) Connect spreader assembly to crane hook with suitable lifting cables.
- 5) Attach lifting cables to each of the spreader eyes and secure other end of cables to skid pad eyes.
- 6) The skid should be lifted into place in a gentle manner in order to ensure safety and avoid damage to the equipment.
- 7) When the skid has been set in place, all lifting apparatus should be carefully removed and promptly stored.



EXPLOSION-PROOF SEAL FITTINGS MUST BE POURED AT THE INSTALLATION SITE

NEPCCO PROVIDES SEALING COMPOUND WITH ALL EXPLOSION PROOF SYSTEMS. IF YOU DID NOT RECEIVE YOUR SEALING PACKAGE, PLEASE CONTACT NEPCCO'S QUALITY ASSURANCE AT 1-800-277-3279

DIRECTIONS FOR POURING SEAL FITTINGS

CK FITTING HUBS WITH FIBER PACKING. DAMS MUST COMPLETELY SURROUND CONDUCTORS AND MUST BE FLUSH WITH CONDUIT HUB HOUSING. MIX TWO PARTS BY VOLUME OF SEALING COMPOUND TO ONE PART OF CLEAN COLD WATER. WARM WATER WILL INCREASE SETTING TIME AND COMPOUND MAY HARDEN TO QUICKLY. DO NOT MIX MORE COMPOUND THAN CAN BE POURED IN 15 MINUTES. POUR SEAL FITTINGS TO CAPACITY AND REPLACE CAPS.

CAUTION:

THIS PROCEDURE SHOULD BE DONE BY ADEQUATELY TRAINED PERSONNEL IN STRICT COMPLIANCE WITH LOCAL AND NEC CODES



Killark Electric Manufacturing Company, A Subsidiary of Hubbell Incorporated, Box.5325, St. Louis, MO 63115

INSTALLATION DATA SHEET

TYPE "EY" & "EYS" SEALING FITTINGS FOR HAZARDOUS LOCATIONS.



FOR VERTICAL CONDUIT



SERIES "EYS"

FOR VERTICAL OR HORIZONTAL CONDUIT

1. GENERAL

(a) Seals are installed in conduit runs to prevent the passage of gases, vapors or flames from one portion of the electical installation to another through the conduit and also for the prevention of precompression of "pressure-piling" of vapors or gases in conduit systems.

(b) In humid atmospheres or wet locations, where it is likely that water could gain entry to the interiors of enclosures or conduit runs, or where temperature and/or barometric changes are likely to produce condensation of moisture within the conduit systems, raceways should be inclined so that water will not collect in seals but will be led to enclosures where it may pass out through approved drains;

2 APPLICABLE CODES

- (a) Article 501-5, SEALING & DRAINAGE, of the National Electrical Code applies to all installations in Class I, Divisions 1 and 2.
- (b) Article 502-5 of the National Electrical Code covers installations in Class II, Divisions 1 and 2.

Important excerpts from the Code are reproduced below, but a thorough review of and familiarity with the code is recommended for all personnel before attempting to locate seals in conduit runs.

- (c) (See Article 501-5 (a) Class I, Division 1) NEC Code 1971.
 - (1) Seals shall be placed in each conduit run entering an enclosure as close as practicable and in no case more than 18 inches from such enclosure.
 - (2) In each conduit run of 2 inch size or larger where 2 or more enclosures are connected by nipples or runs of conduit not more than 36 inches long, a single seal in each conduit is sufficient if located not more than 18 inches from either enclosure.
 - (3) Seals shall be placed in each conduit run leaving the Class I, Div. 1 area, located on either side of the boundary of such area but shall be so designed and installed that no gases or vapors within the Division 1 area may enter or becommunicated beyond the seal.
- (d) (See Article 501-5 (b) Class I, Division 2) NEC Code 1971.
 - (1i) Same as (a-1,2) above. All portions of the conduit run between the seal and enclosure shall conform to Article 501-4 (a), (Rigid conduit required-5 full thread engagement).
 - (2) Seals shall be placed in each conduit run passing from a Class I. Division 2 area into a non-hazardous area, located

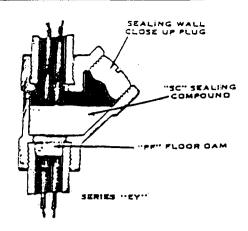
on either side of the boundary of such hazardous area but shall be so designed and installed that no gases or vapors within the Division 2 area may enter the non-hazardous area or be communicated beyond the seal. Rigid conduit must be used between the sealing fitting and the point at which the conduit leaves the hazardous area and a threaded connection shall be used at the sealing fitting.

- (e) (See Article 501-5 (c), Divisions 1 and 2).
 - (1) Sealing fittings must be accesible.
 - (2) Sealing compound shall be approved, shall not be affected by surrounding atmosphere or liquids and shall have a melting point of not less than 93° C. (200° F).
 - (3) In the completed seal the minimum thickness of the seal shall be not less than the trade size of the conduit and in no case less than 5/8 inch.
 - (4) Splices and taps shall not be made in fittings intended only for sealing with compound.
 - (5) Seals must be provided in assemblies where separate compartments contain splices and taps and conductors pass to compartments containing equipment which may produce arcs, sparks and high temperature and the entire assembly must be approved for Class I, Division 1 location.
- (f) (See Article 502-5, Sealing Class II, Divisions 1 & 2). Where a raceway provides communication between an enclosure which is required to be dust-ignition-proof and one which is not, suitable means shall be provided to prevent the entrance of dust into the dust-ignition-proof enclosure through the raceway. This means may be: (1) a permanent and effective seal. (2) a horizontal section not less than 10 feet long in the raceway, or (3) a vertical section of raceway not less than 5 feet long and extending downward from the dust-ignition-proof enclosure. Sealing fitting must be accessible.

3. KILLARK FITTINGS

- (a) Killark Series "EY" Sealing Fittings are suitable for ventical conduit runs and Series "EYS" Sealing Fittings are suitable for either vertical or Horizontal conduit runs for NEC Class 1, Divisions 1 and 2, Groups C and D and for NEC Class II, Divisions 1 and 2, Groups E, F and G locations.
- (b) Killark sealing fittings are produced with utmost care to insure a substantial margin of safety. Made of low-coopercontent aluminum alloy and machined with clean, deep and snug-fitting threads.

CAUTION: Seals should be made ONLY by adequately trained personnel instrict compliance with this instruction sheet. Even slight variations can cause serious field problems. See other side for complete instructions.



4. INSTALLATION OF SEALS

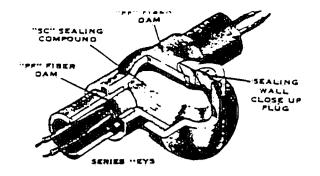
- (a) PROPER MOUNTING POSITION
 - (1) Series "EY" Seals are to be installed only in vertical conduit runs and are available in 1/2 inch thru 4 inch sizes with or without conduit nipples.
 - (2) Series "EYS" Seals may be installed in conduit runs at any angle from vertical through horizontal and are available in 1/2 inch through 4 inch sizes with or without conduit nipples.
- (b) SEALING COMPOUND
 (1) Killark Series "SC" Sealing Compound is suitable for use with Killark Series "EY" and "EYS" seals and is the ONLY compound that should be used in these fittings. Series "SC" compound is a non-shrinking magnesite base coment, dimensionally stable from -100°F, to + 900°F. resists water, acids, oils, electricity and most solvents and is used extensively for sealing conduit to prevent
 - the spread of explosive vapors and reduce pressure piling, (2) Killark Series "SC" compound is not an electrical insulating compound and should not be used for this pur-
 - (3) The insulation on the conductors sealed in the compound may be approved thermoplastics or rubbers, with or without lead covering. Lead coverings need not be removed prior to sealing.
 - (4) "SC" Compound is available in 4 oz., 8 oz. and 1 lb. premeasured packages shipped in a tin container which serves as a mixing vessel, It is also available in 5 lb. and 10 lb. bulk quantities.
 - (5) Approximately 1 oz. of Series "SC" Compound is needed per 1,5 cubic inch of space to be filled. (CHART "A" shows approx, volume and minimum depth of pour to comply with code requirements.)

SIZE	CAT. NO.	MAZ, LOC.	MIN, DEPTH	MATIL IOZI
1/2"	EA2-1	C.1, Gr. C&O, Cl. II, Gr. EFG Cl. I, Gr. C&O, Cl. II, Gr. EFG	5/8" 5/8"	1 2
3/4"	EY-2 EYS-7	a. 1, Gr. C&D, a. 11, Gr. EFG a. 1, Gr. C&D, a. 11, Gr. EFG	3/4" 3/4"	1 7
1"	EYS-3	CI. 1, Gr. C&D, CI. II, Gr. EFG CI. 1, Gr. C&D, CI. II, Gr. EFG	1"	2.5 5.50
1:1/4" !	EY4	Ci. I. Gr. C&D. Ci. II, Gr. EFG	1-174"	4 5
1:1/2"	EY-5 EYS-5	Ct. 1, Gr. C&D, Ct. II, Gr. EFG	1-1/2"	.5 13
·**	EY 6 EY5-8	C. 1, G. CAO, C. II, G. EFG	?" ?"	11 30,5
2-1/2"	EY:7 5YS-7	G. I, Gr. C&O, Cl. II, Gr. EFG G. I, Gr. C&O, Cl. II, Gr. EFG	2-1/2" 2-1/2"	23.
3.	EY-8		J.,	74
3-1/7"	£Y.9		3/1/2**	47
4"	5.Y-0	•	.4**	.48
3.	EYS-8	CI. 1, Cr. C&O, CI. II, Gr. EFG	3"	28.5
3-1/2"	£Y\$-9	C. I. Gr. O. Cl. II. Gr. EFG	3-1/7"	51.
4"	EYS-0	a; I, Gr. D, CI; II', Gr. EFG	,A**	51

CHART "A"

(c) PREPARATION OF DAMS

- (1) A well made dam is the most important element in producing a good poured seal. Improperly packed and weak dams are not only unsafe but waste materials by allowing loss of compound into the conduit systems.
- (2) A dam must be placed in each conduit hub of a sealing fitting, texcept upper nubs of vertical seas).
- (3) Use a narowood stick to force the conductors toward the filling opening.



- (4) Pack Killark Type "PF" Packing Fiber, (available in 4 oz. 8 oz. and 1 lb. units), into each conduit hub in the sealing fitting, (except upper hubs in vertical seals).
- (5) Push the conductors away from the filling opening forcing them apart so they do not lay in contact with each other along their length.
- (6) Force the "PF" packing fiber between each conductor and between the conductors and the hubs and/or integral bushing. (The dam must be tight and strong enough to hold a considerable amount of fluid sealing compound from leaking out before it has time to set).
- (7) Use care so as not to damage the conductor insulation. Be sure to push any shreds of packing fiber away from the conductors to prevent gas leakage paths.
- (8) The completed dam should be even with the conduit stop. (d) MIXING THE COMPOUND
 - (1) GENERAL
 - (a) Use a clean mixing vessel for every batch. Dirt or particles of previous batches will spoil the seat.
 - (b) Recommended proportions are by volume Four parts of dry powder "SC" Compound to one part of clean water. Slight deviations in these proportions will not affect the seal.
 - (c) Do not mix more material than can be conveniently poured in 15 minutes after water is added.
 - (d) If batch starts to set do not attempt to thin by adding more water - discard completely and prepare a fresh batch
 - (e) Be sure the compound level is in accordance with the requirements for the particular fitting being sealed. (See Chart "A").
 - (2) MIXING 4 OZ., 8 OZ. or 1 LB. SIZES "SC" COMPOUND (a) Remove plastic bag from can; shake powdered compound thoroughly to overcome segregation which may have occurred in snipment.
 - (b) Fill can with water to level marked on label. If can is not used - the proportions should be (4) parts compound to (1) part water by volume.
 - (c) Slowly add the compound to the water while mixing thoroughly.
 - (3) MIXING 5 LB. and 10 LB. BULK SIZES "SC" COM-POUND
 - (a) The powdered compound must be mixed thoroughly to overcome segregation that may have occurred in
 - (b) Measure the required amount of water for the quantity required. (See Chart "A") The proportions are (4) parts powdered compound to (1) part water by volume.
 - (c) Slowly add the compound to the water while mixing thoroughly.

(e) POURING THE SEAL

- (1) After compound is mixed slowly pour the fluid compound into the sealing fitting to the level indicated for the particular fitting on Chart "A" being careful to pour slowly so as not to trap air bubbles in the poured seal.
- (2) Immediately wipe off any spilled compound from conduits and threads and close the seal with the appropriate dose up plug (cup) or cover.

CAUTIONS

- (1) Do not attempt to pour seals when the ambient temperature is below 40°F.
- (2) A 40°F minimum ambient temperature must be maintained at the seal for 24 hours after pour in order for the seal to set properly.

REMEMBER TO SAVE ONE OF THESE SHEETS FOR MAINTENANCE PERSONNEL

SKID 1

START UP PROCEDURES IT/PITTSBURGH - VERNAL SITE NEPCCO #729217

ALL SYSTEMS UNDERGO A THOROUGH INSPECTION AND TESTING PROCEDURE AT THE FACTORY. HOWEVER, AS WITH ANY EQUIPMENT AFTER SHIPPING, THE SYSTEM SHOULD BE INSPECTED FOR ANY DAMAGE BEFORE START UP. ALL JOINTS, CONNECTIONS, AND FITTINGS SHOULD BE CHECKED TO ENSURE THAT THEY HAVEN'T LOOSENED DURING SHIPMENT.

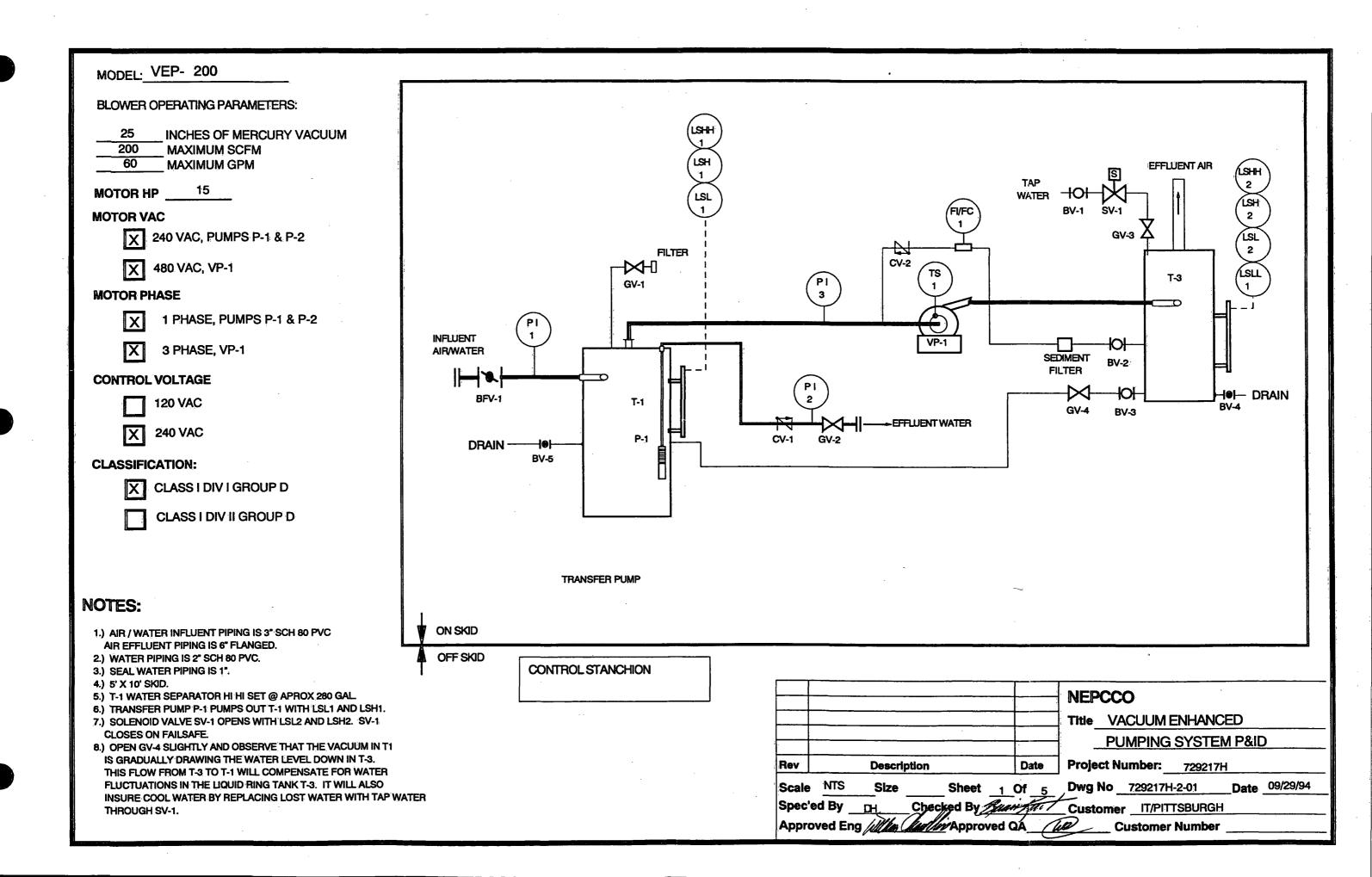
NEPCCO'S SKID MOUNTED SYSTEMS ARE PROTECTED WITH PLASTIC WRAP FOR SHIPPING PURPOSES ONLY. UPON RECEIPT OF THE SYSTEM ALL PROTECTIVE WRAPPING AND TAPE SHOULD BE REMOVED. IF THE SYSTEM IS NOT GOING TO BE OPERATIONAL FOR A TIME, IT IS RECOMMENDED THAT THE SYSTEM BE COVERED TO PROTECT IT FROM THE ELEMENTS.

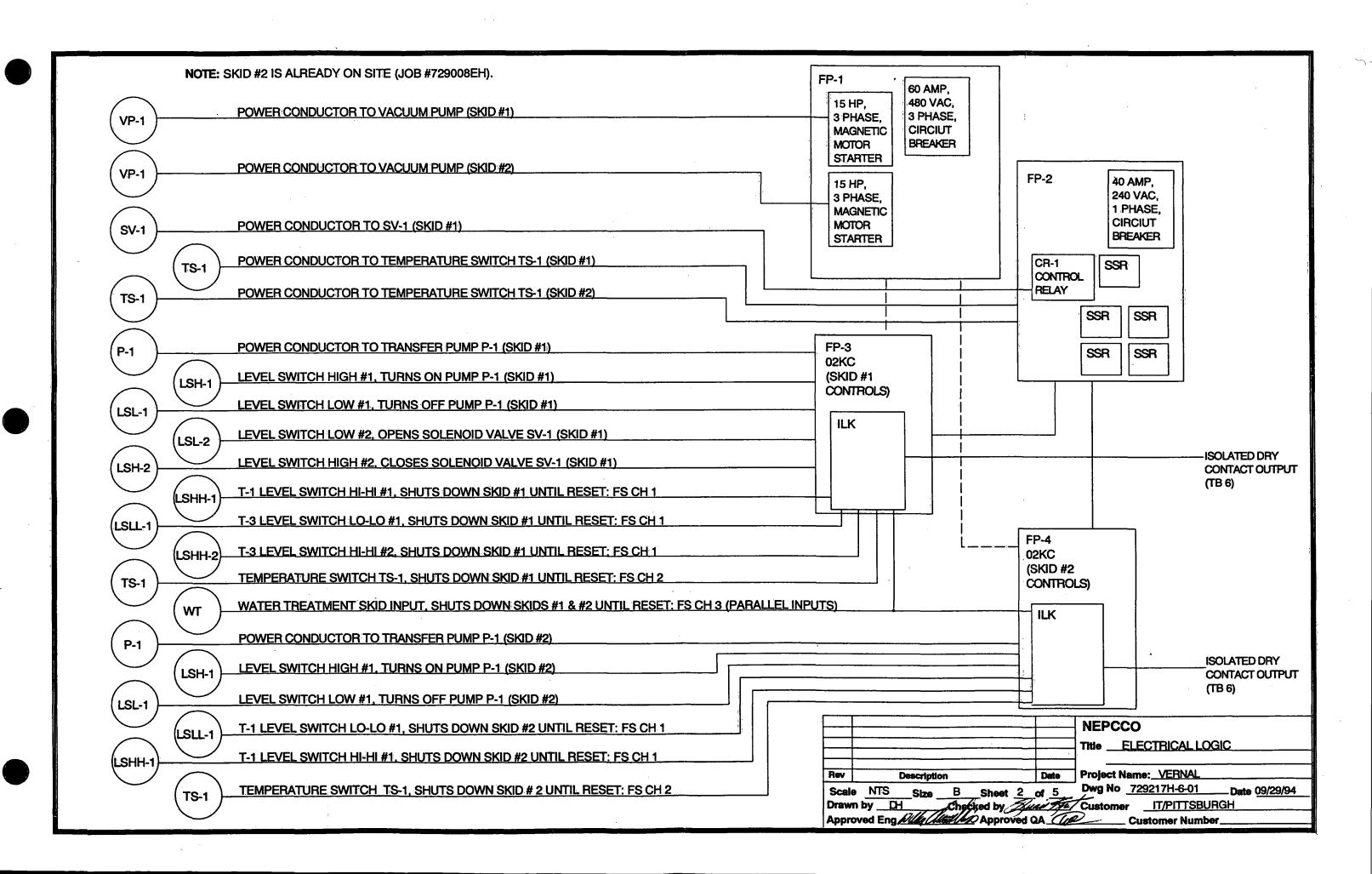
- 1) Read the entire manual before operating this system. The manual contains specific information about the equipment on this system.
- 2) Install skid on a level concrete pad with a minimum perimeter of 6" around the skid base. Anchor bolts or clip fasteners are recommended to secure the skid to the pad.
- 3) Install the influent and effluent water lines to system piping as per process and instrumentation diagram numbered 729217-2-01.
- 4) Connect the tap water line to the VEP system. This line should be able to deliver approximately 5 to 8 GPM.
- 5) Close all petcocks and sample ports.
- 6) Ensure all valves are open/closed per process and instrumentation diagram numbered 729217-2-01.

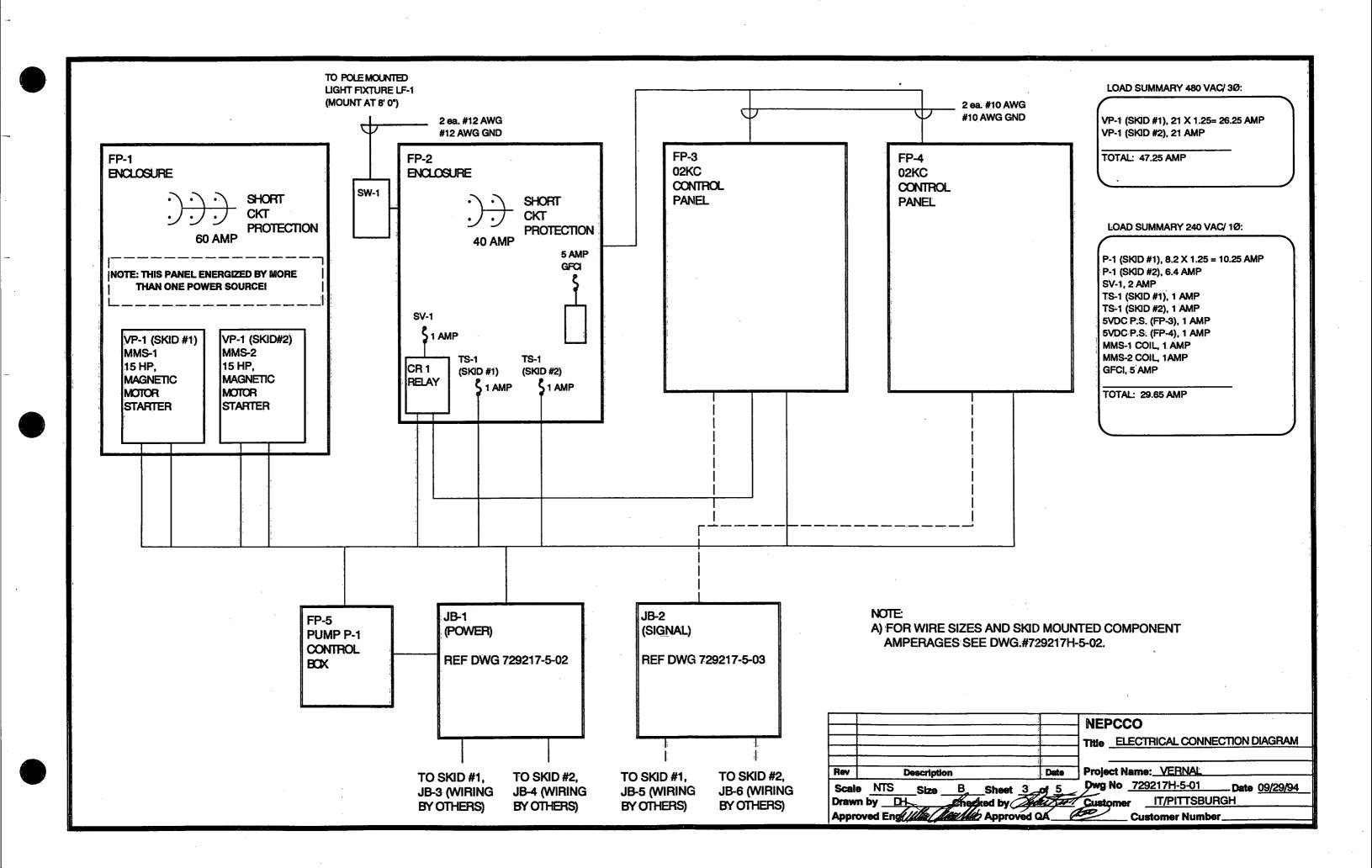
- 7) All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electric Code, local codes and regulations. This system requires 480 VAC three phase and 240 VAC single phase power with neutral and ground. The associated control panels are 240 VAC single phase. Interconnection diagrams are located in section 1 of the system manual. If your system is equipped with seal fittings they must be poured with sealing compound to comply with NEC codes. NEPCCO provides fiber packing and sealing compound with all systems equipped with seal fittings. Instructions for this procedure can be found at the front of the system manual.
- 8) Turn all control panel switches to the "OFF" position and ensure that the system safety switches are in the "OFF" position
- 9) Turn on power at the main power disconnect (supplied by others on site) then apply power to the system by switching the system safety switch to the "ON" position.
- 10) Before starting the vacuum pump it is imperative that the seal water/air water separator tank be filled. To accomplish this it will be necessary to place channel 2 on the 02KC (FP-3) to the "AUTO" position and hold the failsafe reset button in for a time to overide the Level Sensor Lo-Lo on the seal water tank multi-level probe. Once the water level has reached the Lo-Lo sensor, release the reset button. The solenoid will remain open until the water has reached the correct level and then close.
- 11) Place channel 1 on the 02KC to the "AUTO" position for transfer pump operation. Open the butterfly valve on the influent line and start the Vacuum Pump by placing the pump control switch on Field Panel 1 to the "ON" position. Adjust the flow indicator/flow controller on the seal water line to 5 GPM. Transfer pump P-1 will pump as required.
- 12) Start the other Vacuum Pump in the same manner.

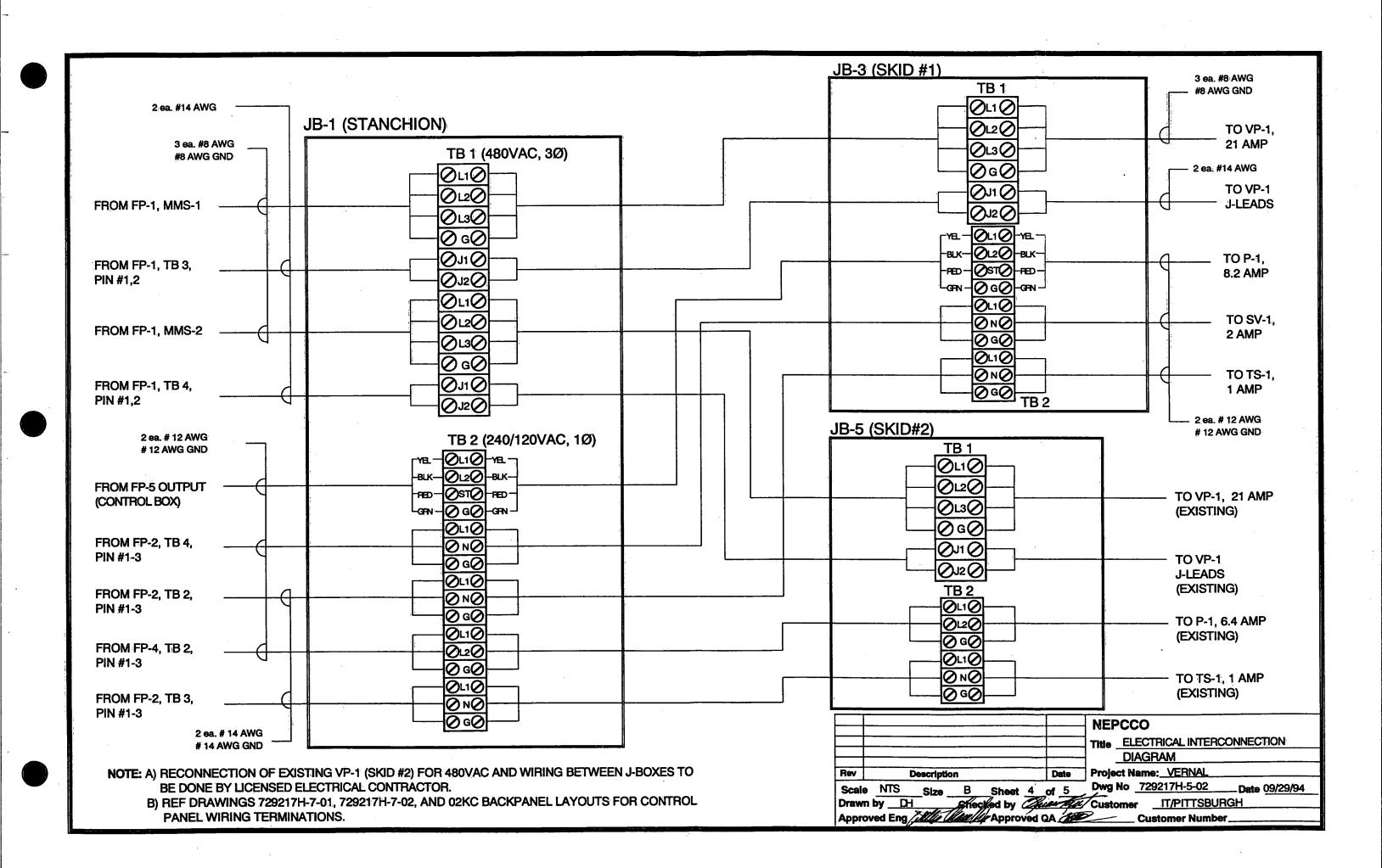
- 13) Monitor the system and check operating parameters for satisfactory performance.
- 14) The system manual includes individual equipment and component specifications and adjustment procedures necessary for initial start up and regular maintenance.
- 15) If there are any problems with or questions about your system, we will be glad to resolve them. Please call our toll free number @ 1-800-277-3279.

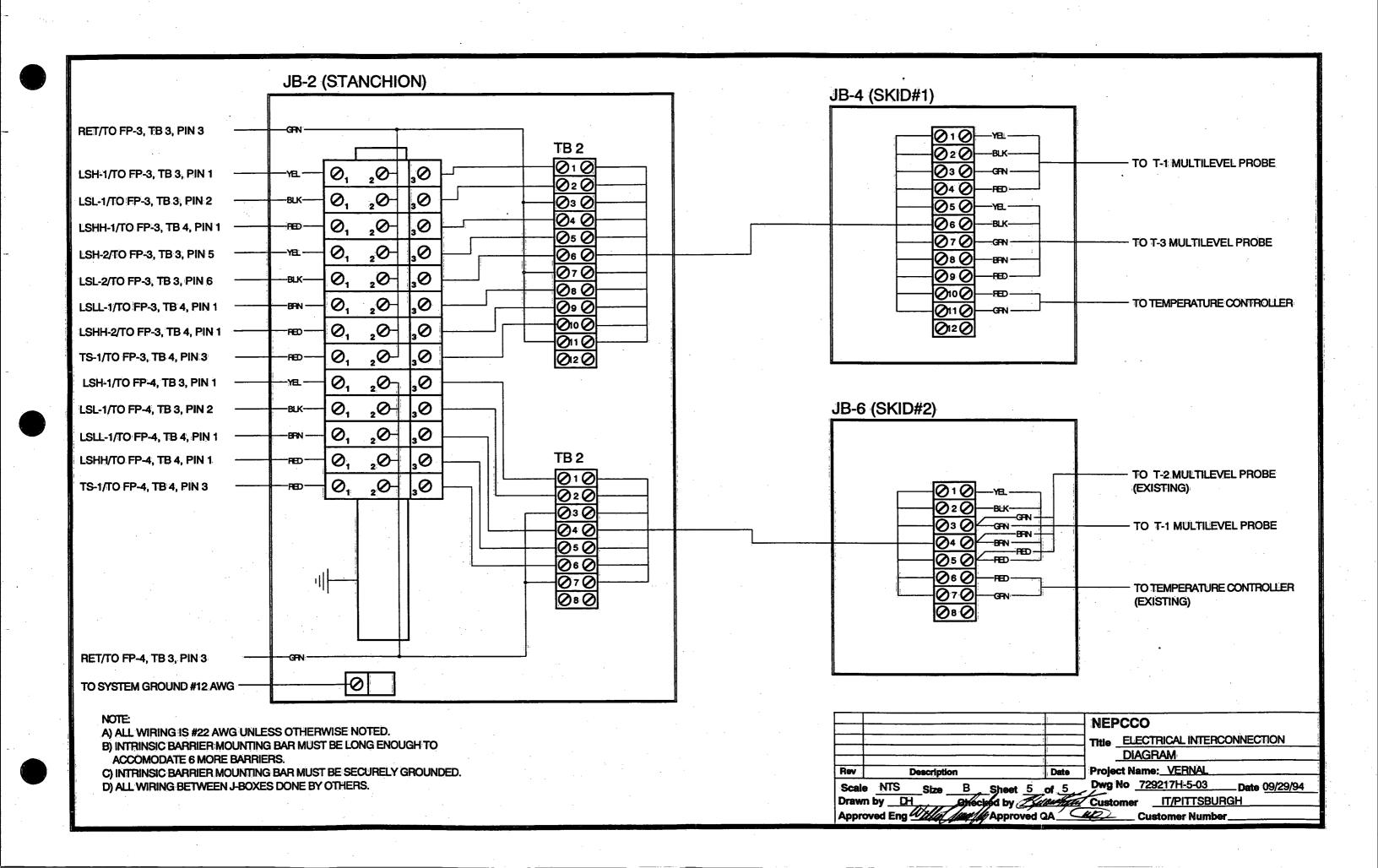
1-800-277-EASY

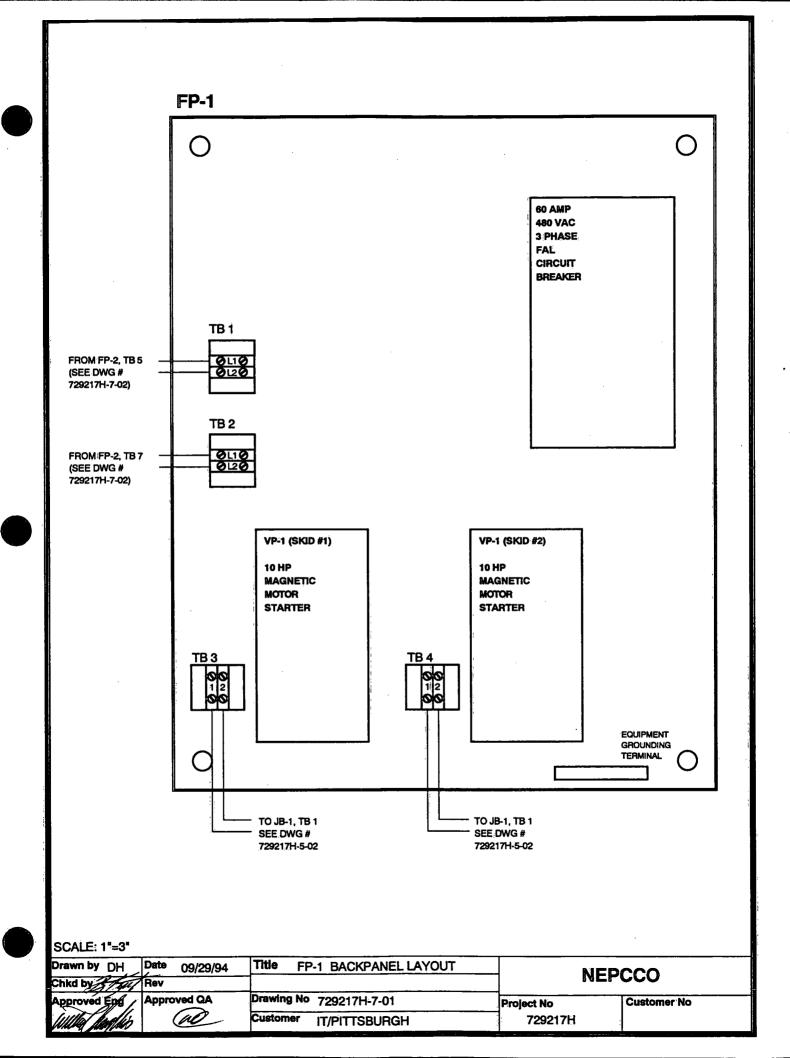


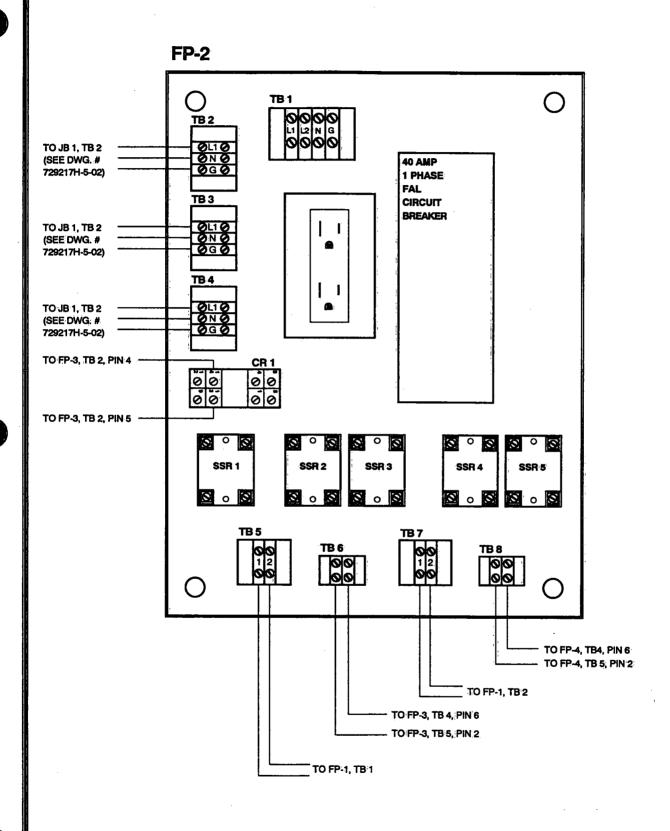












SCALE: 1"=3"

Drawn by DH Date 09/29/94 Title FP-2 BACKPANEL LAYOUT

Chkd by FRev

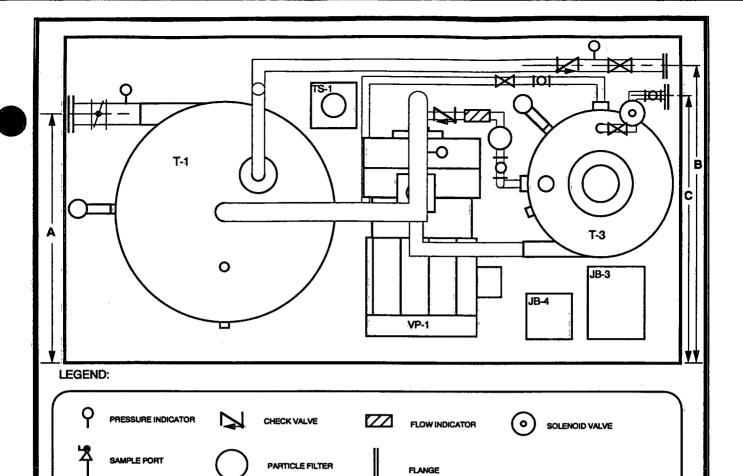
Approved Eng Approved QA

Customer | T/PITTSBURGH

Drawing No 729217H-7-02

Customer | T/PITTSBURGH

Project No 729217H



	iL.	W	Н	DIA	HP	VOLTAGE	PHASE	GAL	CFM	GPM	NEMA	
SKID SIZE	10'	5'	4"	,		:						
CONTROLS						240	1				4	
VACUUM TANK			48"	48"				300	225			
SEAL WATER TANK			48"	24"								
PACKED COLUMN												
VACUUM PUMP					15	480	3				7	
AIR COMPRESSOR												
SURGE TANK		\bigcap					1					
TOT FLUIDS PUMP					1	240	1			60		
FLOW TOTALIZER										†		

BUTTERFLY VALVE

GATE VALVE

101

BALL VALVE

- 1.) AIR INFLUENT A = 50 AND EL = 45" TO GRADE (MEASUREMENTS ± 1")
- 2.) WATER EFFLUENT **B** = $\frac{56}{}$ AND EL = 10" TO GRADE (MEASUREMENTS \pm 1")
- 3.) WATER INLET C = 46 " AND EL = 48" TO GRADE (MEASUREMENTS ± 1")

Drawn by DH Date 09/29/94	Title ASBUILT LAYOUT DRAWING	. NIE	NEPCCO			
Chkd Hev	VEP SYSTEM	IN.				
Approved Eng Approved QA	Customer Approval	Project No	Customer Number			
Title Charles Over	Customer IT/PITTSBURGH	729217H				

COMPONENT LIST

PROJ	ECT N	IAME: IT/PI	ITSBURGH	9/29/94	
ITEM	NO. REQ.	P&ID LABEL	DESCRIPTION AND SPECIFICATIONS	PART NUMBER	SERIAL NUMBER
	VEP	SYSTEM			
1	1		SKID, 5' X 10'	150-0002	
2	1	FI/FC-1	FLOW INDICATOR, 3/4", 2-8 GPM	MNPT-7206	
3	1	BVF-1	BUTTERFLY VALVE, 3"	120-0480	
4	1	GV-1	GATE VALVE, 1.5" BRASS	40-0147	
-5	1	GV-2	GATE VALVE, 2" PVC	40-0121-01	
6	1	GV-3	GATE VALVE, 1" BRASS		
7	4	GV-4	GATE VALVE, 1" PVC	40-0095	
8	5	BV/1-5	BALL VALVE, 1" PVC	40-0139	
9	1	CV-1	CHECK VALVE, 2"	40-0131	
10	1	CV-2	CHECK VALVE, 1"	40-0098-01	
1.1	1	PI-2	PRESSURE INDICATOR, 0-60 PSI	150-0016-01	
12	2	PI-1, 3	PRESSURE INDICATOR, 0-30" Hg VACUUM	150-0013	
13	1	TS-1	THERMOCOUPLE	STOCK	
14	1		SLIM LINE SEDIMENT FILTER W/ 50 MICRON FILTER	#10 SLIMLINE	
15	1	SV-1	1" N.C. SOLENOID VALVE W/ 120VAC, XP COIL		
16	1	FILTER	1.5" FILTER	120-0965	
	TAN	KS			
17	1	T-2	AIR WATER SEPARATOR TANK REUSE AS SEAL WATER TANK		
18	1	T-1	300 GAL. AIR WATER SEPARATOR TANK, VACUUM RATED 29" HG		
	PUMI	PS			
19	1	VP-1	LIQUID RING VACUUM PUMP MODEL # A-200 WITH 15 HP, 480 VAC, 3 Ø, XP MOTOR		18053
20	1	P-1	TOTAL FLUIDS PUMP END W/	45G2008	2183
21	1	P-1	FRANKLIN MOTOR, 2 HP, 3 WIRE, 240 VAC, 1 PH	100-0051	2182
22	1		FRANKLIN CONTROL BOX	2823018110	
	MOT	OR STARTE	RS		
23	9	FP-1	MAGNETIC MOTOR STARTER, OPEN TYPE FOR 15 HP, 480 VAC, 3 PH,		
0	_	• • •			

240V COIL, W/ ON-OFF SWITCH, LEGEND PLATE, & CONTACT BLOCK

COMPONENT LIST

PROJ	ROJECT NAME: IT/PITTSBURGH		ITSBURGH	9/29/94	
	NO.	P&ID		PART	SERIAL
ITEM	REQ.	LABEL	DESCRIPTION AND SPECIFICATIONS	NUMBER	NUMBER
	CON	TROLS (NE	AA 4)		
24	1	FP-1	HOFFMAN ENCLOSURE, 24" X 20" W/ BACKPLATE, A-24H20ALP, A-24P20	33-0430	729217-I
25	1	FP-1	SQ D OPERATING MECHANISM, 9421-LF1	33-0434	
26	1	FP-1	SQ D HANDLE, 9421-LH43	33-0435	
27	1	FP-1	SQ D SHAFT, 9421LS8	33-0433	
28	1:	FP-1	480 VAC TYPE FAL CIRCUIT BREAKER, 60 AMP, 3 PHASE	FAL36060	
29	1	FP-2	HOFFMAN ENCLOSURE, 20" X 16" W/ BACKPLATE, A-20H16ALP, A-20P16		729217-II
30	4	FP-2	SQ D OPERATING MECHANISM, 9421-LF1	33-0434	
31	1.	FP-2	SQ D HANDLE, 9421-LH43	33-0435	
32	1	FP-2	SQ D SHAFT, 9421LS8	33-0433	
33	1	FP-2	240 VAC TYPE FAL CIRCUIT BREAKER, 40 AMP, 1 PHASE	FAL22040	
34	1		MANUAL ENCLOSURE BOX	50-0425	
35	1	TS-1	GRM W/ CLEAR COVER TO HOUSE TEMPERATURE CONTROLLER	33-0001	
36	1	FP-2	CLASS 8501 GENERAL PURPOSE RELAY & BASE	RS42V24/NR42	
37	1	FP-3	02 KC CONTROL PANEL, W/ FS NEMA 4	50-0086	729217-111
38	1	FP-3	HYDRO/HYDRO LOGIC CARD	50-0018-01	563
39	1	FP-4	02 KC CONTROL PANEL, W/ FS NEMA 4	50-0086	729217-IV
40	1	FP-4	HYDRO/HYDRO LOGIC CARD	50-0018-01	512
41	1	FP-2	BOXOUTLET	33-0147	
2	1	FP-2	RECEPTACLE	33-0162	
43	2	JB-1,2	12" X 10" HOFFMAN ENCLOSURE	33-0078	
44	1.3	JB-1	GEMS SINGLE CHANNEL ZENER BARRIER	113000	
45	1	JB-3	GRLENCLOSURE	9033-0049	
46	3	JB-4,5,6	GRIM ENCLOSURE	33-0001	
4.7	1	TS-1	TEMPERATURE CONTROLLER	T0-1114	
48	1	SW-1	BOX OUTLET	33-0147	
49	1	SW-1	SINGLE GANG WEATHERPROOF SWITCH COVER FOR ABOVE ITEM		
50	1	SW-1	1 POLE SWITCH , 15 AMP		
51	1	LF-1	WP LIGHT FIXTURE W/ BOX, WALL MOUNT	TBGG100	

PROBES & EXTENSIONS

52	1	LSH/LSL-1	MULTILEVEL PROBE,	VACUUM	TANK (CUSTOM)	

53 1 LSH/LSL-2 MULTILEVEL PROBE, SEAL WATER TANK (CUSTOM)

SKID2

START UP PROCEDURES IT/PITTSBURGH #519063 NEPCCO #729008EH

ALL SYSTEMS UNDERGO A THOROUGH INSPECTION AND TESTING PROCEDURE AT THE FACTORY. HOWEVER, AS WITH ANY EQUIPMENT AFTER SHIPPING, THE SYSTEM SHOULD BE INSPECTED FOR ANY DAMAGE BEFORE START UP. ALL JOINTS, CONNECTIONS, AND FITTINGS SHOULD BE CHECKED TO ENSURE THAT THEY HAVEN'T LOOSENED DURING SHIPMENT.

NEPCCO'S SKID MOUNTED SYSTEMS ARE PROTECTED WITH PLASTIC WRAP FOR SHIPPING PURPOSES ONLY. UPON RECEIPT OF THE SYSTEM ALL PROTECTIVE WRAPPING AND TAPE SHOULD BE REMOVED. IF THE SYSTEM IS NOT GOING TO BE OPERATIONAL FOR A TIME, IT IS RECOMMENDED THAT THE SYSTEM BE COVERED TO PROTECT IT FROM THE ELEMENTS.

- 1) Read the entire manual before operating this system. The manual contains specific information about the equipment on this system.
- 2) Install skid on a level concrete pad with a minimum perimeter of 6" around the skid base. Anchor bolts or clip fasteners are recommended to secure the skid to the pad.
- 3) Install the influent and effluent water lines to system piping as per process and instrumentation diagram numbered ES-1-100-040.
- 4) Connect the tap water line to the VEP system. This line should be able to deliver approximately 5 to 8 GPM.
- 5) Close all petcocks and sample ports.
- 6) Ensure all valves are open/closed per process and instrumentation diagram numbered ES-1-100-040.

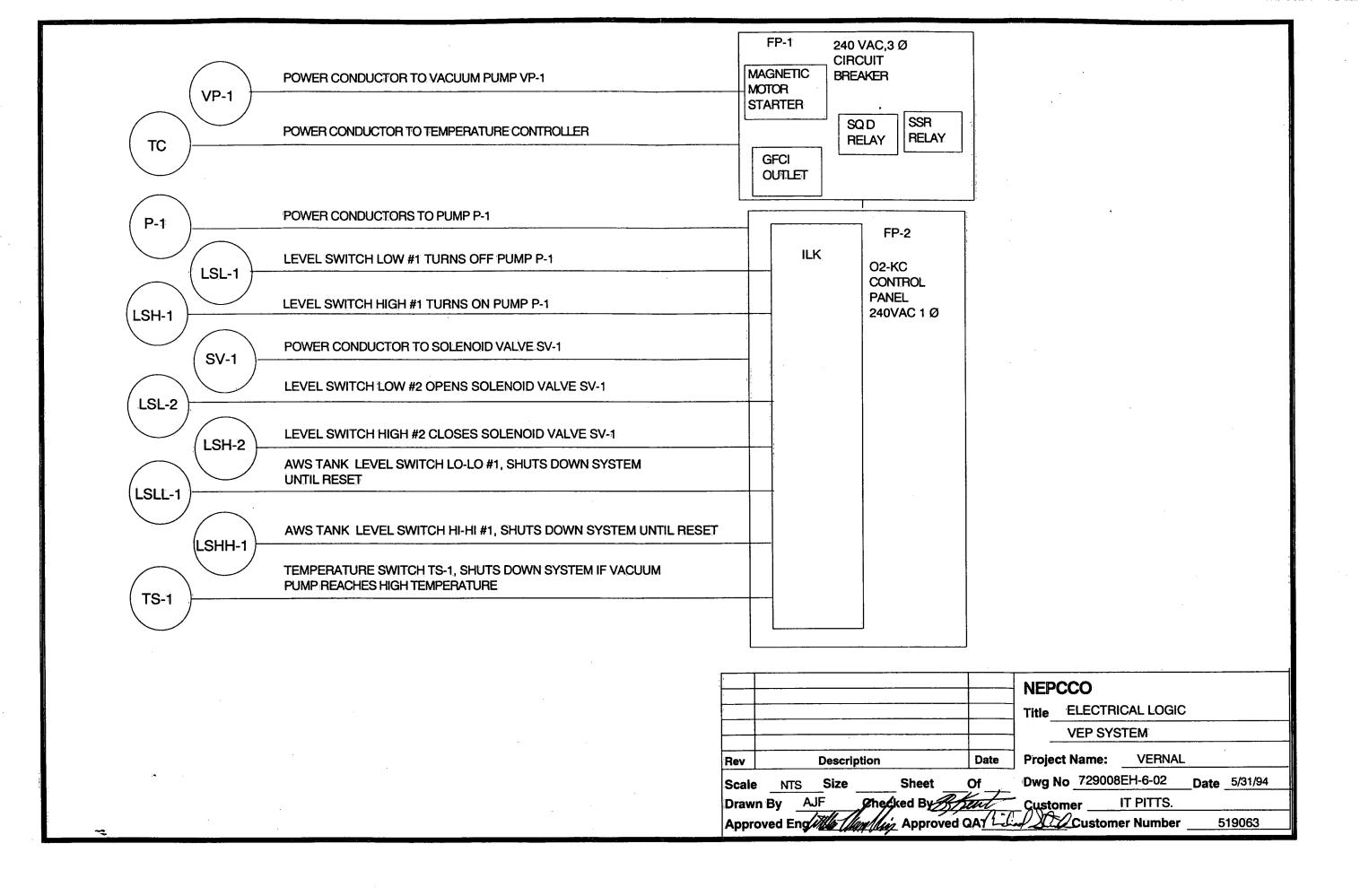
- 7) All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electric Code, local codes and regulations. This system requires 240 VAC three phase power. The associated control panels are 240 VAC single phase with neutral and ground. If your system is equipped with seal fittings they must be poured with sealing compound to comply with NEC codes. NEPCCO provides fiber packing and sealing compound with all systems equipped with seal fittings. Instructions for this procedure can be found at the front of the system manual.
- 8) Turn all control panel switches to the "OFF" position and ensure that the system safety switches are in the "OFF" position
- 9) Turn on power at the main power disconnect (supplied by others on site) then apply power to the system by switching the system safety switch to the "ON" position.
- 10) Before starting the vacuum pump it is imperative that the seal water/air water separator tank be filled. To accomplish this it will be necessary to place channel 2 on the 02KC to the "AUTO" position and hold the failsafe reset button in for a time to overide the Level Sensor Lo-Lo on the seal water tank multi-level probe. Once the water level has reached the Lo-Lo sensor, release the reset button. The solenoid will remain open until the water has reached the correct level and then close.
- 11) Place channel 1 on the 02KC to the "AUTO" position for transfer pump operation. Open the butterfly valve on the influent line and start the Vacuum Pump by placing the pump control switch on Field Panel 1 to the "ON" position. Adjust the flow indicator/flow controller on the seal water line to 5 GPM. Transfer pump P-1 will pump as required.
- 12) Monitor the system for satisfactory operation.

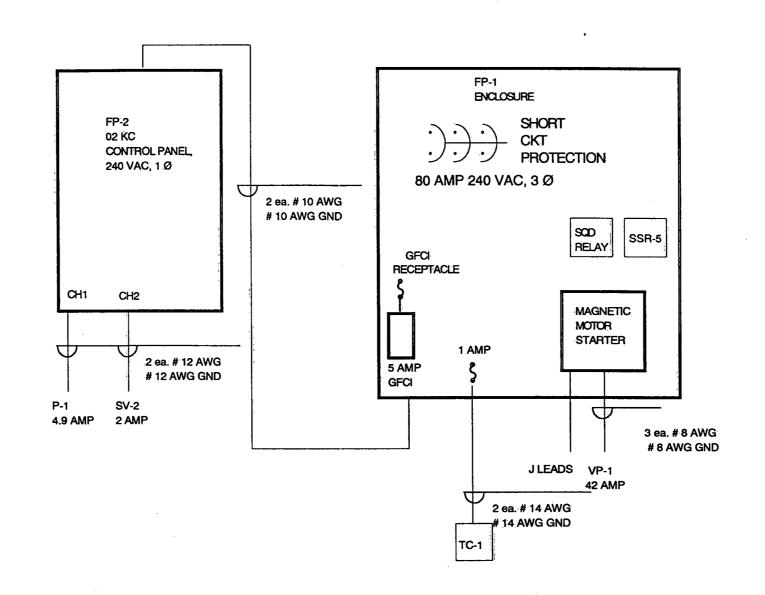
- 13) The system manual includes equipment specifications and adjustment necessary for the components to aid in the initial start up and continued maintenance.
- 14) If there are any problems with or questions about your system, we will be glad to resolve them. Please call our toll free number @ 1-800-277-3279.

1-800-277-EASY

MODEL: VEP- 220		
BLOWER OPERATING PARAMETERS:		(LSHH)
INCHES OF MERCURY VACUUM MAXIMUM SCFM MAXIMUM GPM	FILTER	TAP WATER OF TO THE TOTAL TOTA
MOTOR HP MOTOR VAC 240 VAC	INFLUENT 1 1 GV-1 FILTER BFV-1 SCREEN	BV-1 SV-1 CV-1 CSH 2 OPTIONAL LSLL 1 CV-1 CV-1 CSH 2 OPTIONAL CV-1 CSH 2 OPTIONAL CV-1
480 VAC		TS
MOTOR PHASE 1 PHASE	P ₁	SEDIMENT T-1
☑ 3 PHASE		VP-1 FILTER O
CONTROL VOLTAGE 120 VAC	FIELD	BV-2 BV-3 BV-3 EFFLUENT WATER
240 VAC	FIELD PANEL	GV-2
CLASSIFICATION:		TRANSFER PUMP
CLASS I DIV I GROUP D	ONSKID	
CLASS I DIV II GROUP D	OFF SKID CAUTION: NO	OT FOR PUMPING SEPARATE PHASE PRODUCT
NOTE:		
1.) AIR / WATER INFLUENT PIPING IS 3 SCH 80 PVC AIR / WATER EFFLUENT PIPING IS 2 SCH 40 C.S 2.) WATER PIPING IS 1 SCH 80 PVC. 3.) SEAL WATER PIPING IS 1. 4.) SK-4% SKID 5.) T1 WATER SEPARATOR IS 60 GALLON.		NEPCCO Title STANDARD VACUUM ENHANCED PUMPING SYSTEM P&ID Rev Description Date Project Number: 729008 EH
6.) SOLENOID VALVE SV-1 OPERATES ON LSL2 AND LS OR LSH1 & LSL1. X-FER PUMP P-1 OPERATES ON LSL1 AND LSH1. SV-1 CLOSES ON FAILSAFE.	H2 	Scale NTS Size Sheet Of Dwg No ES-1-100-040 Date 05/23/94 Spec'ed By Akt Checked By State Customer IT PITTS BURGH Approved English Approved QA Customer Number 579063

- ---





LOAD SUMMARY:

3 Ø, 240 VAC POWER:

P-1, 4.9 AMP X 1.25= 6.125 AMP SOLENOID VALVE, 2.AMP P.S.,1 AMP GFCI, 5 AMP COIL, 1 AMP 42 X 1.25 = 52.5AMP

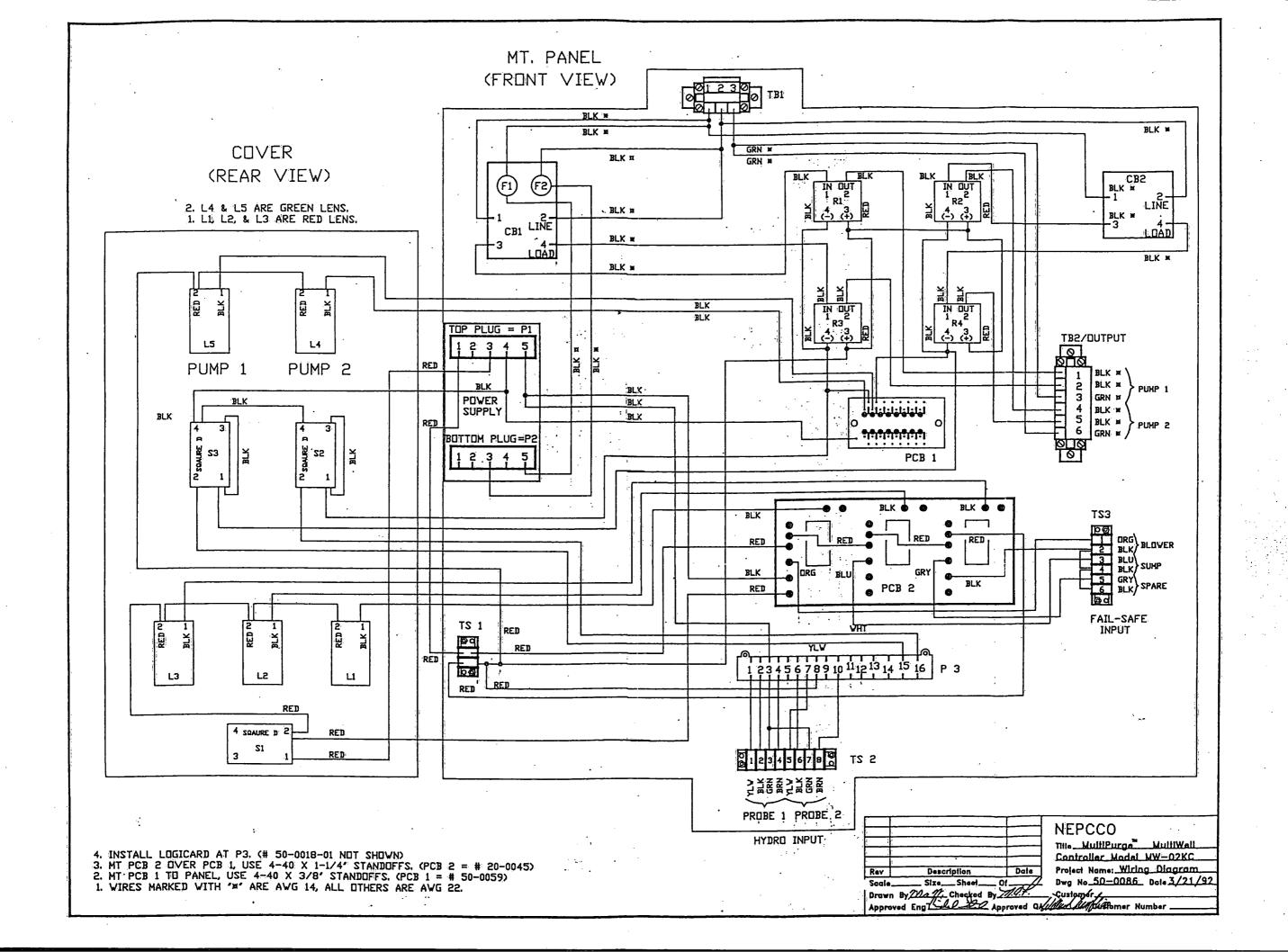
TOTAL 67.625 AMP

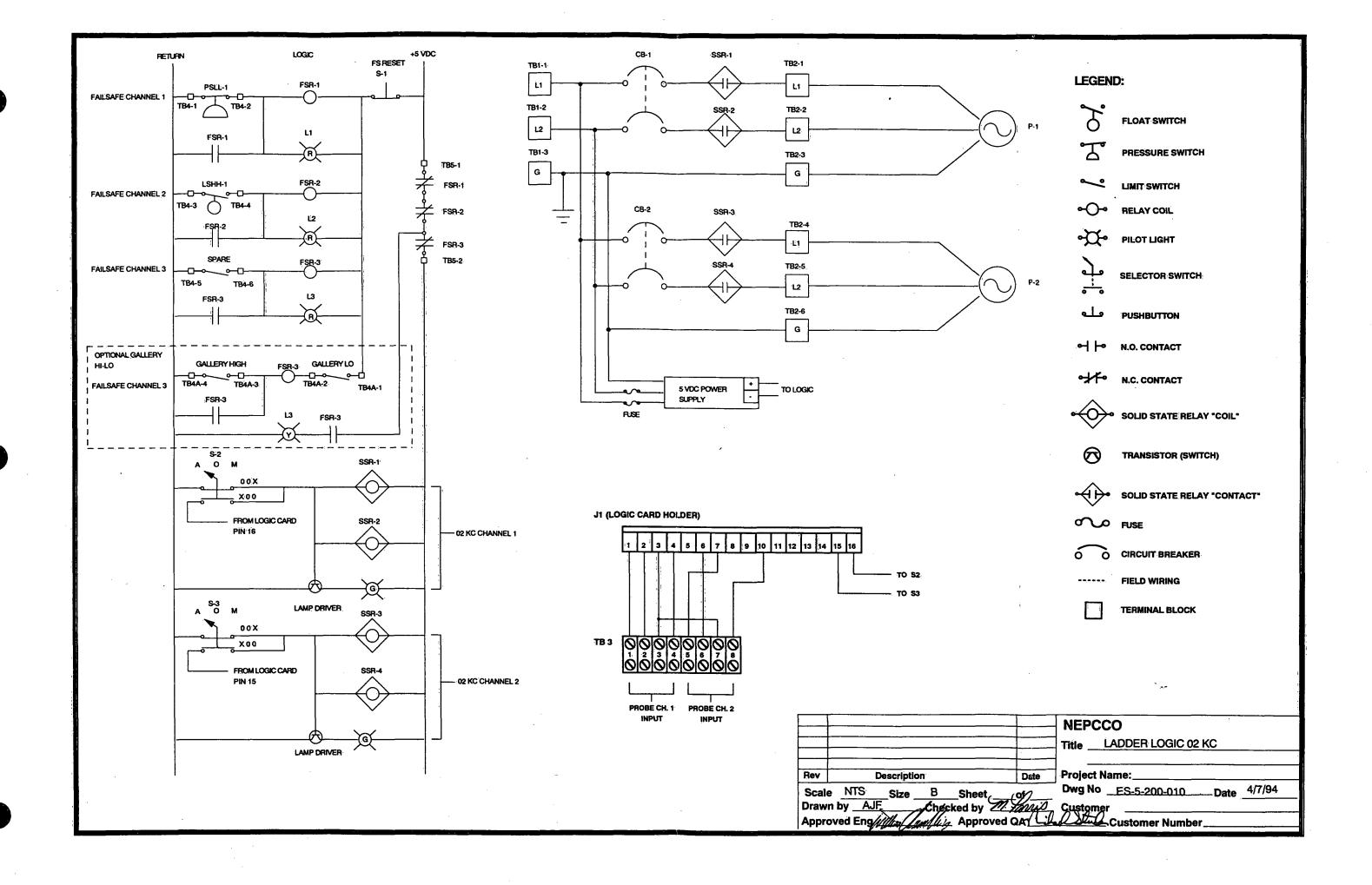
NOTE: CONNECT: POWER: ACCORDING NEC CODE 384-3

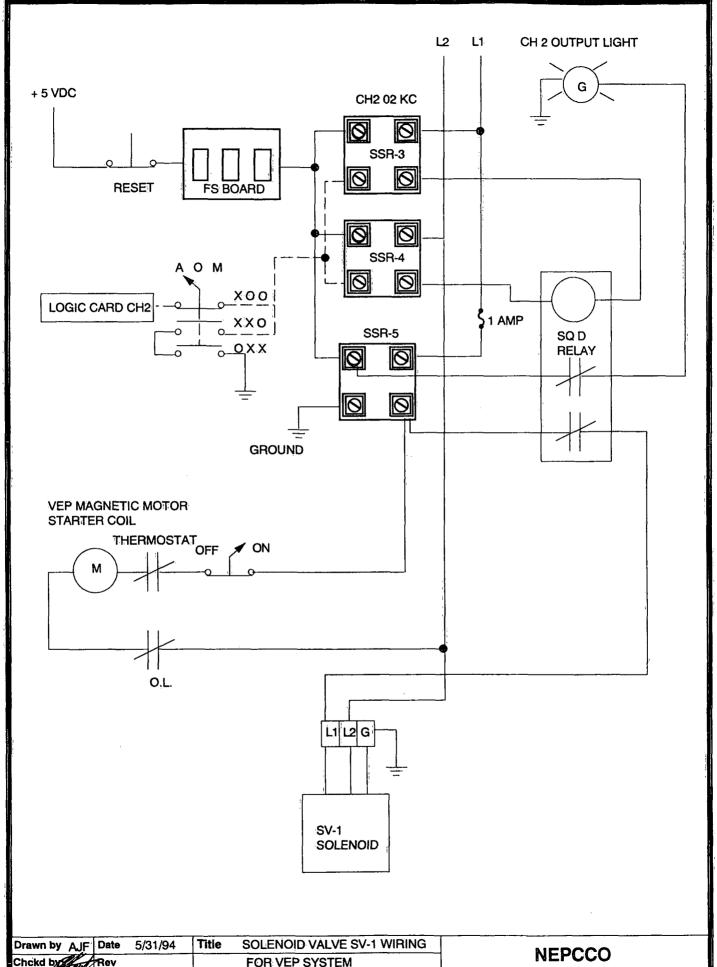
					NEPCCO Title ELECTRICAL CONNECTION DIAGRAM
					VEP SYSTEM
Rev		Descript	on	Date	Project Name: VERNAL
Scale	NTS	Size	Sheet	Of	Dwg No 729008EH-5-01 Date 5/31/94
Drawn	By _	AJF (hegked By	Sent	Customer IT PITTS.
Appro	ved Eng	Helle I le	Approve	d QA	Customer Number 519063

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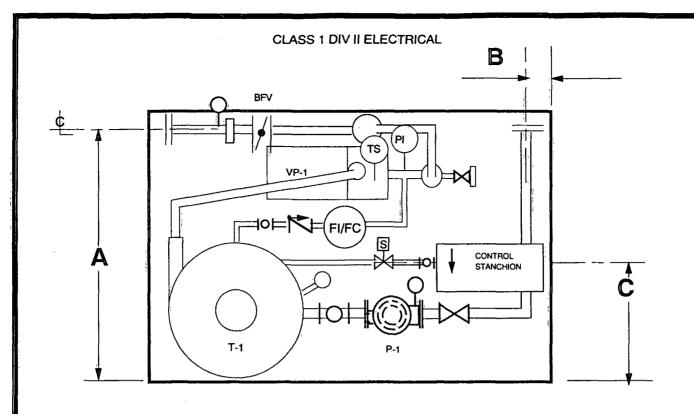
E company on			34414	50			PONENTS			
	PIPING		VALV			COM	PUNEN 13		ELECTRIC	AL
	Major Pr Seconda Process	s Line	PRV	Pressure Reducing Valve	₽		North Arrow	 \(\hat{B}\)\	. .	Electrical Line
		and Mate	SRV	Safety Relief Valve	X		Item Label	(R)	ΕI	Panel Light Front of Panel Device
	Union Orifice		VRV	Vacuum Relief valve			Pitot Tube Velocity Measurement		HS, OOA	Hand Switch On / Off / Auto
		Disconnect M		Motorized Valve Actuator		PF	Particulate filter Gas or Liquid		FS, LSHH,	Field Device Flow Sensor Level Sensor HI - HI
The second secon	Expansion	ion Joint	PUMPS & E	BLOWERS	PH	BS	Basket Strainer		LSH, LSL, LSLL, PI,	Level Sensor High Level Sensor Low Level Sensor LO - LO Pressure Indicator
		gm Isolator	P	Centrifugal Pump		ΑL	Alarm Light		PSHH, PSLL, PT,	Pressure Sensor HI - HI Pressure LO - LO Pressure Transmitter
	Line list Direction	n of Flow 문 나	P	Pneumatic Submersible Pump			Flame Arrestor		dPI, TI	Differential Pressure Indicator Temperature Indicator
	Entry an	nd Exit Flow	•	очинегаше Рапр	<u> </u>	ME	Mist Eliminator	LABELS		ABELS
	VALVES		P	Electric Submersible Pump	<u></u>	SN	Spray Nozzle			anulated ActivatedCarbon
		/alve, Open	D			A W C	Muffler		FS- Flo	eld Panel ow Switch ow Totalizer
		Valve, Open	P	Metering Pump		A, VV 3	Air Water Separator		M - Mo	ensor Interlock otor ower Disconnect essure Element
	G L V Globe	Valve, Open Valve, Closed	P	Double Diaphragm Pump Gear Pump	\bigcirc	FQ	In-Line Flow Meter Or Rotameter		PT- Po	ort Hole
	C V Check G V Gate V	/alve, Open	Р	asar i amp					· · · · · · · · · · · · · · · · · · ·	
		/alve, Closed	Р	Peristaltic Pump				NEPCCO Title SY		D ABBREVIATIONS
	ISI	fly valve oid-Valve	В	Centrifugal Blower					ES-1-010-0	
	D¶ SP Sample	e Port	В	Rotary Lobe Blower				Approved Er	ng William	M. Champlin



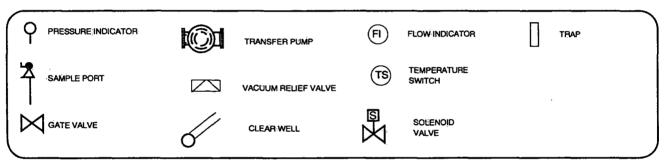




Drawn by AJF Date 5/31/94	Title SOLENOID VALVE SV-1 WIRING	NED	CCO
-Chckd by Rev	FOR VEP SYSTEM	NEP	
Approved Eng Approved QA	Drawing No 729008EH-5-02	Project No	Customer No.
willing till I to	Customer IT PITTSBURGH	729008H	519063



LEGEND:



	L	W	H	DIA	HP	VOLTAGE	PHASE	GAL	CFM	GPM	NEMA
SKID SIZE	6'	4'	4"				i				
CONTROLS		i .				240	1				4
SEAL WATER TANK			48"	24"							;
AIR WATER SEP.											
TRANSFER PUMP					3/4	240	1	_		15	XP
LIQUID RING PUMP					15	240	3		220	20	XP
				 						 	
<u> </u>		 		-						 	

- 1.) AIR / WATER INFLUENT A = 43.1/4 " AND EL = 39.5" TO GRADE 2.) WATER EFFLUENT B = 3.5 " AND EL = 9.5" TO GRADE 3.) SEAL WATER INFLUENT C = 21 " AND EL = 37" TO GRADE

Drawn by AJF Date 5/31/94	Title STANDARD VEP-220	AIC	PCCO
Chckd by Rev	LAYOUT DRAWING	INE	PUU
Approved Fing / Approved QA	Customer Approval	Project No	Customer Number
Wille hay ly Thisal Side	Customer IT PITTSBURGH	729008EH	519063

COMPONENTS LIST

THE FOLLOWING ITEMS ARE REQUIRED FOR PROJECT # 729008EH

	NO. REQ. SKID	P&ID LABEL SYSTEM	DESCRIPTION AND SPECIFICATIONS	PART NUMBER	SERIAL NUMBER
1	1	SK-75	SKID, 4' X 6'	150-0002-01	
2	1	FI/FC-1	FLOW INDICATOR, PIPE SIZE 3/4", 2-8 GPM FLOW RANGE, TACO 7206		
3	1	BFV-1	BUTTERFLY VALVE, 3"	120-0480	
4	1	GV-2	GATE VALVE, 1"	40-0095	
-5	1.	GV-1	GATE VALVE, 1.5"	40-0147	
6	3	BV-1, 2, 4	BALL VALVE, 1" PVC	40-0095	
7	1	BV-3	BALL VALVE, 2"	40-0143	
8	1	CV-1	CHECK VALVE, 1" PVC	40-0098-01	
9	1	P1-3	PRESSURE INDICATOR, 0-60 PSI	150-0016-01	
10	2.	PI-1, 2	PRESSURE INDICATOR, 0-30" VACUUM PSI	120-0600	
11	2	FILTER	10 MICRON PARTICLE FILTER	120-0960	
1.2	1	SV-1	3/4" SOLENOID VALVE, 240 VAC, NORMALLY CLOSED, XP		D74B94
1'3	1		SEDIMENT FILTER VESSEL #10 SLIM LINE W/ PR, & MODEL CP-10 FILTER	RCARTRIDGE	
14	1		INLINE PARTICLE TRAP		
	TANK	(S			
15	1	T-1	AIR WATER SEPARATOR TANK		
	PUMP	PS			
16	1	VP-1	ATLANTIC FLUIDICS, MODEL A200, 15 HP, 240 VAC, 3 Ø, XP		17743
17	1	P-1	TRANSFER PUMP, GRUNDFOS MODEL CR2-20UV		1193
18	1	P-1	MOTOR; 56C, 3/4 HP, 240V, 1 Ø, 3450 RPM, XP MOTOR W/ THERMAL O.I	L .	7
	CON	TROLS (NE	MA 4)		
19	1	FP-1	HOFFMAN ENCLOSURE, 20" X 16" W/ BACKPLATE, APH20ALP, A20P16	50-0405	729008-İ
20	1	FP-1	BOX OUTLET		
21	1	FP-1	RECEPTACLE		
22	. 1	FP-1	SQ D OPERATING MECHANISM, 9421LF1		
23	-	FP-1	SQ D HANDLE, 9421LH43		•
24	1	(FP-1)	SQ D SHAFT, 9421LS8	EASTOOOD	
25	1	FP-1	240 VAC TYPE FAL CIRCUIT BREAKER, 80 AMP, 3 PHASE	FAL32080	
26	1	ED 0	MANUAL ENCLOSURE BOX	50-0425	700008 H
27	1	FP-2	02 KC CONTROL PANEL, W/ FS NEMA 4	50-0086	729008-lil 563
0.0	4	CD 4	LOGIC CARD	DC 40VO40/NE	
28	1	FP-1	CLASS 8501 GENERAL PURPOSE RELAY & BASE	RS42V240/NF	142
29	1 MOT	OR STARTE	GRM & LID TO HOUSE TEMPERATURE CONTROLLER RS		

MAGNETIC MOTOR STARTER, OPEN TYPE FOR 15 HP, 240 VAC, 3 PH, 240 VAC 1 FP-1 COIL, W/ ON-OFF SWITCH AND LEGEND PLATE

PROBES & EXTENSIONS

1 LSH/LSL-1 MULTILEVEL PROBE, FOR AWS TANK

SENSORS

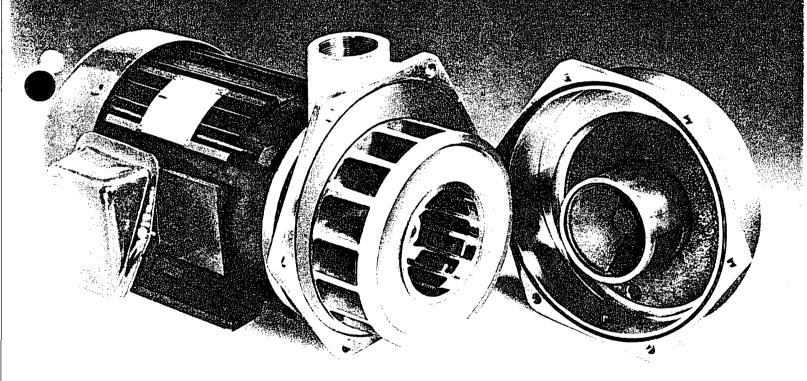
TS-1 LFE MODEL 1400 CONTROLLER, W/ ALARM CONTACT AND ADHESIVE SURFACE T/C TYPE "T"

SECTION 2

VACUUM PUMP



Liquid Ring Vacuum Pumps



Installation and Service Manual

Dear Customer,

The goal of this manual is to provide you with long, maintenancefree operation and step-by-step instructions for complete repairs in the field. We feel that the more you know about our pumps, the more you will appreciate their engineering and construction and the less likely you will ever be confronted with costly down time.

The pumps described in this booklet are all close-coupled to "C" Face motors and require no special baseplates, couplings, guards, or additional labor for alignment. Our philosophy is that pump heads should never require complete replacement and our experience confirms this. Most repair work is minor and we take some pride in being able to offer our customers pumps that are not disposable and which can be serviced without special tools or skills. Keeping the end user in mind was always a virtue of Yankee Ingenuity and Atlantic Fluidics continues in that tradition.

When pumps leave our factory, they have been fully tested and readied for use, and we maintain complete files on performance results and service history by the serial number stamped in the top lip of each casing. You may refer to this number whenever a question may arise or advice is needed for installation, trouble-shooting, or for ordering spare parts.

We are confident you will be pleased with your new pump and stake our reputation on how you recommend us.

Best Wishes

Henry Huse President

Contents

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1.0 General Description

1.1 LIQUID RING VACUUM PUMPS - PRINCIPLE OF OPERATION

The liquid ring pump removes gases by means of an impeller rotating freely in an eccentric casing. The pumping is done by a liquid, usually water, that is fed into the pump and thrown by centrifugal force into a moving ring along the casing or cover wall.

When gas or vapor enters the suction port, it is trapped by the whirling impeller blades and a liquid piston that expands in the eccentric lobe of the casing. As the impeller rotates, the liquid is then pushed inward by the narrowing space between rotor and casing, compressing the trapped pocket of gas. Finally the compressed gas is released through a discharge port as the impeller completes the revolution.

The direct contact between the liquid ring and the gas makes the pump ideal for wet applications and for handling condensibles that are discharged with the gas and liquid. Unlike rotary vane and piston pumps, the operation of a liquid ring vacuum pump is nearly isothermal and without vibration. There is no oil to be changed or pollutant released into the environment. Because there are no valves and no rubbing parts, a liquid ring pump is virtually maintenance-free.

With liquids other than water, vapor pressure in the pump can be reduced for high vacuum or compatibility achieved with specific process gases. In some cases, distillate or another fluid is introduced directly into the suction pump inlet and used as the liquid seal.

Liquid ring pumps are also commonly staged with positive displacement blowers, air and steam ejectors for greater capacity and higher vacuum. Atlantic Fluidics offers many such staged units—including its patented Fluid-Vac two-stage system with roots-type blower, liquid ring back up and unique fluid coupling design.

1.2 FLUID-VAC SPECIAL FEATURES

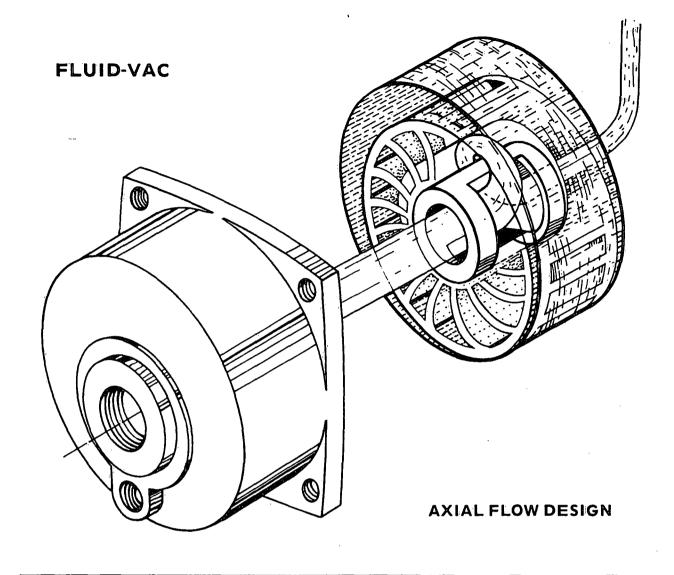
One of the distinguishing features of an Atlantic Fluidics' pump is an axial flow design that permits the widest range and highest vacuum of any single-stage liquid ring pump. A fixed port cylinder concentric with the rotor bore directs the gas along the shaft axis, into the suction ports of the rotor, and finally back through the rotor and rear of the pump for discharge.

Because the gas flow is along the motor shaft (and not at right angles), the pump can start flooded without damage and has excellent water handling capacity. The use of a shrouded rotor also increases pumping efficiency for high vacuum and lower water consumption. The pump head, close-coupled to a "C"-Face motor, is extremely compact and requires no interstage manifold as do the older style pumps and their copies.

Further advantages to Fluid-Vac pumps include the use of modern O-Rings and Mechanical Seals rather than gaskets and stuffing boxes, and a replaceable port cylinder for fast in-the-field repair. The standard material of construction is bronze with a hardened aluminum bronze rotor so that any wear or damage is relegated to the least expensive parts.

1.3 WARRANTY

The seller warrants and guarantees products of its manufacture against defective workmanship or material for a period of one year from the date of shipment from its factory. This warranty and guarantee is expressly and strictly limited to replacing without charge any part or parts which prove to its satisfaction, upon examination, to have been defective and which have not been neglected, abused or misapplied, provided the Buyer gives the Seller immediate



written notice upon discovery of any claimed defect. Material deemed defective must be returned to the factory, transportation charges to and from the factory to the place of origin pre-paid, F.O.B.

Anything herein to the contrary notwithstanding, the Seller will guarantee component parts manufactured by others, including, but not limited to, prime movers, starting equipment, electrical apparatus, and auxiliary fittings only to the same extent of the guarantee made by the manufacturer of such equipment.

1.4 SERVICE and PARTS

Fluid-Vac pumps are 100% designed and manufactured in the United States. All parts are maintained in inventory for immediate shipment from our factory in Stamford, Connecticut. At the back of this manual is a list of parts and recommendations for spares to keep on hand.

The reputation of Atlantic Fluidics is staked on fast service and practical assistance in designing vacuum systems for specific applications. Specializing in the liquid ring field, the company was created by and for ENGINEERS.

2.1 LOCATION

Because of its close-coupled design, a Fluid-Vac pump is ideal for applications where space is critical. Its vibrationless operation permits direct bolting to the floor or mounting on a baseplate anywhere that is convenient for piping. The standard motors furnished by Atlantic Fluidics are of either the Open Drip Proof (ODP) variety, for dry indoor locations, or Totally Enclosed Fan Cooled (TEFC) for areas where the motor may be exposed to water. Special motors are available for hazardous locations.

The pump needs no adjustment, alignment or coupling, guard, etc., and because the pump runs COOL, no special ventilation is necessary—or access for checking sight glasses and oil.

In choosing a location, the main consideration should be the pump's proximity to the vacuum system and convenience for draining discharge and piping the seal water.

2.2 GENERAL PIPING INSTRUCTIONS

The Inlet, Discharge and Seal Water Piping require observance of three basic rules:

- A. Piping must be free of all welding shot, slag and other foreign matter that could damage pump.
- B. Piping must be supported independently to avoid stress on pump casing.
- C. Piping should be of the same diameter as the pipe connections on pump.

2.21 VACUUM INLET PIPING

Inlet piping is a simple matter of connecting the pump to the vacuum system. Models A10, A15 and A20 vacuum pumps have threaded one inch connections on their covers for direct piping. The larger pumps feature flange faces.

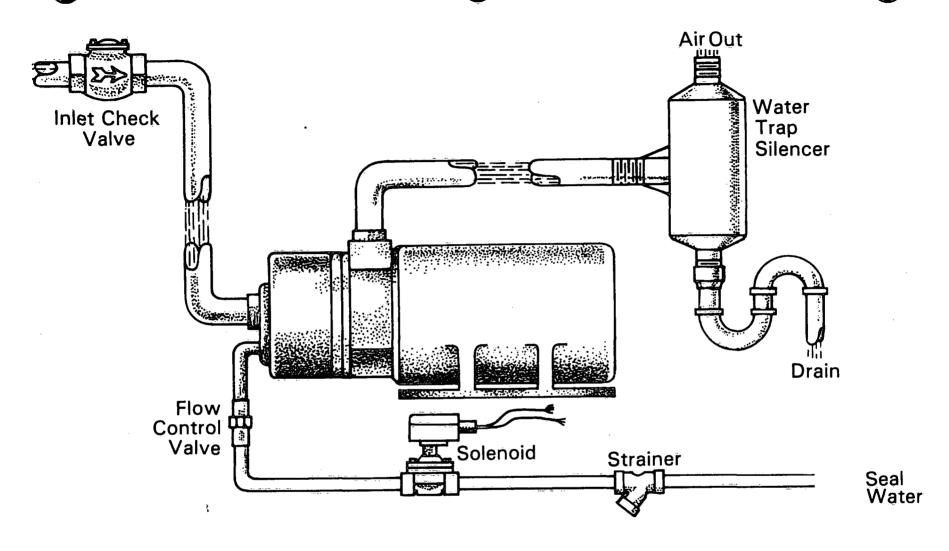
An inlet check valve is recommended to prevent vacuum loss and back streaming when the pump shuts down. Avoid using spring loaded valves not designed for vacuum service.

An optional vacuum gauge can be mounted between the pump and check valve to measure inlet vacuum.

2.22 DISCHARGE PIPING

Depending on the application, there are a number of ways to handle the discharged liquid and gas. If there are no pollutants, the simplest scheme is to discharge directly into a drain. An Atlantic Fluidics pump can carry up to a ten foot discharge head provided the piping from that height is pitched toward a drain or other receptacle. EXCESSIVE BACK PRESSURE CAN ADVERSELY AFFECT PUMP PERFORMANCE.

A second method is to run the discharge through a mechanical separator removing water from the gas. Water contaminated by sanitary waste or noxious gas may be recirculated as seal water or discharged into a sanitary sewer or tank. The nature of the contaminant will determine how often recirculated water must be changed.



PIPING SCHEMATIC

2.23 SEAL WATER PIPING

Unless liquid is pumped directly through the vacuum inlet connection, most applications require separate piping for seal water to enter the pump. The seal water inlet is located directly below the vacuum inlet on the pump's face. Water, the most widely used liquid seal, can be piped directly from a tap or recirculated from a discharge separator tank. Be sure to specify if seal liquids other than water are to be used: Atlantic Fluidics will make recommendations regarding compatibility of materials, power requirements etc.

The following accessories are recommended:

A. Flow control valve (see Seal Water Requirements)

B. Solenoid Valve (to shut off water when pumping stops)

C. Strainer (to prevent foreign matter from entering the pump)

For more information about recirculating seal water, consult Atlantic Fluidics.

2.3 ELECTRICAL CONNECTIONS

Refer to the motor label or conduit box for correct wiring. Most motors are three phase and will be damaged if single phased. Derating for 50 cycle operation at different voltages is possible if specified on motor label. Otherwise, refer questions to manufacturer or Atlantic Fluidics.

Be sure to jog motor before start-up to insure correct wiring and rotation.

3.0 Operation

3.1 SEAL WATER REQUIREMENTS

Fluid-Vac liquid ring pumps, because of their exclusive axial flow design, have the ability to handle large amounts of water and can start up flooded without damage. Seal water flow is not critical and flow rates can be adjusted for a wide variety of applications. For most applications the optimum seal water rates are given below:

	Vacuum Range		
Pump Model	0" - 10" Hg.	10" - 25" Hg.	Over 25" Hg.
A5	1.0 GPM	1.5 GPM	2.0 - 3.0 GPM
A10	1.0 GPM	1.5 GPM	2.0 - 3.0 GPM
A15	1.5 GPM	2.0 GPM	2.0 - 3.0 GPM
A20	2.0 GPM	2.0 GPM	2.5 - 3.5 GPM
A75	2.0 GPM	2.5 GPM	3.0 - 4.0 GPM
A100	2.0 GPM	2.5 GPM	3.0 - 4.0 GPM
A130	2.0 GPM	3.0 GPM	4.0 - 5.0 GPM
A200	3.0 GPM	5.0 GPM	6.0 - 8.0 GPM

The water supply can be regulated by either a flow restrictor or manually by valve. The object is to balance performance against water consumption and power.

THE PUMP MUST NEVER RUN DRY. The solenoid valve must be in an open position for pumping.

3.2 START-UP

Once the pump is fully piped and wired for operation, be sure no foreign matter may enter and possibly damage the pump. Check for welding shot, slag or other metal bits.

Before starting the pump, turn the motor shaft by hand to be sure it is free to rotate. On TEFC motors, you may turn the rear fan. With ODP motors, the rotor can be turned via the discharge port or the front vents beneath motor.

If a hard rub is experienced, the pump should be checked internally for interference. As long as the shaft can be turned by hand, the pump is operable. A hard rub is indicative of improper alignment, and the pump should be disassembled and realigned.

A final check is to jog the motor, making sure water is introduced into the pump and that rotation is in accordance with the arrow cast on pump face. If no flow of air or vacuum reading is immediately apparent, rewire the motor accordingly. Rotation should be counter clockwise facing the pump inlet.

The pump is now ready for operation.

3.3 STOPPING PUMP

Once the power is shut off, be sure water is stopped from entering the pump. A solenoid valve in the seal water line is recommended to shut off flow simultaneously with cessation of pumping.

An inlet check valve is recommended to prevent vacuum loss or back flow to the system.

3.4 MAINTENANCE

As a general rule, maintenance is not required for Fluid-Vac pumps. Because there are no rubbing parts and with water acting as coolant and lubrication during pumping, wear is minimized. It is recommended that the motor bearings be greased every four years. For further information refer to the Trouble-Shooting Chapter of this manual.

To prevent foreign matter from entering the pump, a strainer is recommended for the seal water line and the usual precautions taken in the pump inlet piping.

4.0 Trouble shooting

4.1 PUMP WILL NOT TURN ON START- UP

- (a) Check wiring and power to pump.
- (b) Remove pump cover to check for anything that may be binding the rotor. Be sure that the rotor turns freely by hand, (Sec. 3.2)
- (c) On cast iron pumps, check for internal rust if pump has been left idle for a long period. Rust can build up to the point where internal clearances are closed. Remove rust and reassemble.
- (d) In areas where there is hard water being fed into the pump, check for scale deposits that may hinder rotation. Scale should be removed by acidizing, but refer to the factory for recommended procedures.

(e) If the motor fails to turn, be sure it isn't a motor problem. Burn-out may occur if a three-phase motor is single phased.

4.2 NO PUMPING ON START-UP

- (a) Check pump rotations. It may be rotating in reverse. Rewire motor to correct.
- (b) Check seal water. Water must be fed continuously into the pump.

4.3 POOR PUMP PERFORMANCE, LOW VACUUM

- (a) Check vacuum pump while running by sealing off inlet piping and reading vacuum at the pump suction. If high vacuum is achieved, look for leaks in the vacuum system. The pump capacity is a function of high vacuum performance and will conform to the published performance curve at standard conditions. High seal water temperatures will lower the vacuum because of the increase in vapor pressure. Altitude, barometric pressure, and gas temperature can also affect high vacuum performance.
- (b) If high vacuum is not achieved on blank-off, the problem lies in the vacuum pump. Poor pump performance can be caused by the following:
- Pump may not be getting enough water.
 Adjust water supply and observe change in the performance.
- Internal parts may be worn or badly scarred. Remove cover/port cylinder assembly and check for wear on the port cylinder, rotor and cover lands. Most wear will be limited to the softer bronze port cylinder which should slide easily into the rotor bore. Replace port cylinder if necessary. You may also polish the port cylinder and rotor bore with a fine emery cloth for smooth fit.

4.4 PUMP UNUSUALLY NOISY

- (a) Unusual continuing noise from the motor end is probably an indication that the motor bearings are bad. Remove cover and spin rotor by hand. You should be able to detect bearing noise. If indicated, replace motor bearings.
- (b) Cavitation. The vacuum pump should not be operated on blank suction for any length of time. When liquid ring vacuum pumps are starved for air, cavitation will result in a rattling noise and vibration in the pump. Cavitation can be eliminated by providing a slight air bleed into the vacuum system.

4.5 HIGH AMPS

- (a) Flooding the pump with too much water, particularly at low vacuum, can overload the motor. Adjust seal water supply.
- (b) Internal rubbing of rotor with stationary parts can cause excessive loading. Shut off pump and rotate by hand (see 3.2) to see if rotor turns freely. Internal rubbing may be due to scale build-up, a galling foreign material or by misalignment of parts. (see 4.1 & 4.3b)

5.0 Service and Repair

5.0 SERVICE and REPAIR

Fluid-Vac liquid ring vacuum pumps have been designed to minimize down time by allowing for fast in-the-field repair. Time and money-saving features include:

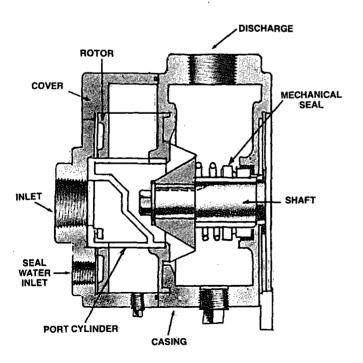
- Modern O-Rings and mechanical seals for zero leakage and easy replacement.
- Front end disassembly for fast access to major internal parts.

- Shaft mounted assembly for easy alignment and indicating.
- Replaceable port cylinder that unscrews from cover and requires no special shimming or adjustment.
- Standard rotor made of G-metal and Aluminum bronze to relegate wear and damage to the softer port cylinder.
- American-made stock parts available for immediate shipment.

5.1 DISASSEMBLY OF PUMP

The pump may be disassembled while bolted to the baseplate by removing suction and seal water piping and working from cover to motor. Most repair work will not require full disassembly, but please refer to the exploded pump diagram in following these steps:

- (a) Shut off all valves controlling flow of fluids to and from the pump casing. Disconnect external piping.
- (b) Remove bolts connecting cover to casing. The cover and port cylinder assembly will slide straight outward. The port cylinder is dismounted from cover by removing three socket head cap screws.
- (c) Remove hex head lock screw and washer from motor shaft. Use a bearing puller to remove rotor without damage to casing. Be sure to protect the threaded shaft bore.
- (d) Slide shims, mechanical seal, sleeve bushing and O-Ring off shaft.



- (e) Unbolt casing from motor face.
- (f) Save any and all shims from shaft and casing assemblies for proper realignment.

5.2 ASSEMBLY OF PUMP

Before commencing assembly of the pump, carefully inspect all parts for signs of unusual wear, abrasion and corrosion. ORings should be checked for cracks or brittleness and the carbon face of the mechanical seal examined for scratches.

Replace all parts as needed and proceed as follows:

STEP ONE: Casing, Sleeve and Seal Assembly

The mechanical seal is composed of a seat (#8a), seal (#8b), and spring (#8c). The seat is a ceramic ring with a rubber boot that is pressed firmly into the rear of casing. Lubricant is recommended for ease in inserting rubber boot in the seal housing bore. BE VERY CAREFUL NOT TO SCRATCH THE CERAMIC FACE DURING HANDLING AND INSERTION.

Once the seal seat is in place, mount casing (#1) on the motor face using the original shims for alignment. The larger pump casings are mounted on four studs extending from motor face, while the smaller casings (Models A10, 15, 20) are secured by four hex head bolts.

Next slip the small O-Ring (#11) over shaft till it touches the shaft shoulder and place the sleeve/bushing (#9) on top so that its chamfered end presses against O-Ring.

To complete the assembly, lubricate the sleeve so that the rest of the mechanical seal (#8b) can be pressed on with the carbon face in flat sliding contact with the ceramic seat. Again, AVOID SCRATCHING OR TOUCHING THE CARBON FACE. Proper tension between the seal faces is provided by the spring – leading to Step 2.

STEP TWO: Rotor Assembly and Alignment

The rotor is secured to the shaft by means of a key (#15), a hex head lock screw (#13), and a brass washer (#14). In order for the rotor to turn freely, there must be some clearance between it and the casing. On models A10, A15, and A20, this clearance is established by adding shims (#10) until no rub is felt between the back of the rotor and the casing face. On the larger pumps, shims are used to position the rotor so that the casing face lines up with the inside wall of the rotor shroud. (See photograph below)

Be sure to use a bearing puller when removing rotor to add more shims. Avoid damage to the casing face and to the threaded shaft bore. Once secured, the rotor should spin freely without any interference or rub from the casing.

To insure proper alignment, you may indicate the run-out on the front edge of the rotor. If the rotor appears to be cocked more than 2 or 3 thousandths when tightened down, find the high spot and if it is not drastically out, a light rap with a mallet will bring the rotor into correct alignment. Tightening down the rotor is facilitated by using a long bolt and several washers before inserting the actual lock bolt.

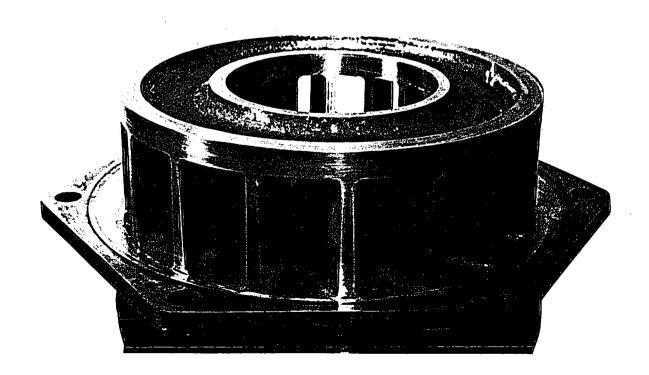
STEP THREE: Port Cylinder Assembly and Cover

The port cylinder (#3) is readily mounted on the cover (#4) by three socket head cap screws with nylon plugs (#6). A fiber gasket (#5) is used to seal the surface between cover and port cylinder while the alignment of tapped holes insures correct placement.

The final assembly is to insert O-Ring (#12) into the cover groove and then to slide the port cylinder/cover assembly into the rotor bore. The surface where cover and casing meet will be sealed by the O-Ring.

In securing the cover to the casing, the cover bolts (#19) must be drawn up uniformly. During tightening, the rotor should be turned by hand to insure easy rotation when the pump is fully assembled. Loosen the bolts and then tighten again if a hard rub is experienced. (Note that Models A75 and A100 have two socket head bolts which should be used in the bottom cover holes.)

After the drain plugs (#17, #18) have been installed with teflon tape on the threading, the vacuum pump is ready for service.



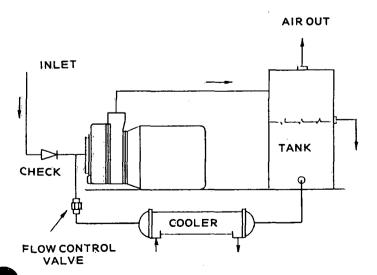
Save Water, Time and Money with FLUID-VAC Sealant Recovery Systems

In applications where water is costly, scarce or unavailable, Fluid-Vac Sealant Recovery Systems provide simple, compact and environmentally safe options for recirculating seal water and storing waste.

THE BASIC SYSTEM

The standard configuration for recirculating seal water is to pipe the pump discharge into a small separator tank where non-condensed gas is vented into the atmosphere and the water returned to the pump inlet. By having a tee connection in the inlet piping for the return (rather than through the separate seal water inlet), the pump will draw its own water requirement controlled by a flow restrictor in the return line.

The basic system offered by Atlantic Fluidics is a completely self-contained pumping system that fits almost anywhere for intermittent or low vacuum use. The package includes a close-coupled pump, baseplate, stainless steel separator tank with complete seal water and discharge piping.



HEAT EXCHANGERS

For continuous high vacuum use, a heat exchanger is recommended to counter the temperature rise from the heat of compression. Higher seal water temperatures will increase the partial gas pressure inside the pump and limit high vacuum performance. Used in conjunction with water chillers, refrigeration units, fan coils or cooling towers, a properly sized heat exchanger will maintain seal water temperatures for maximum performance.

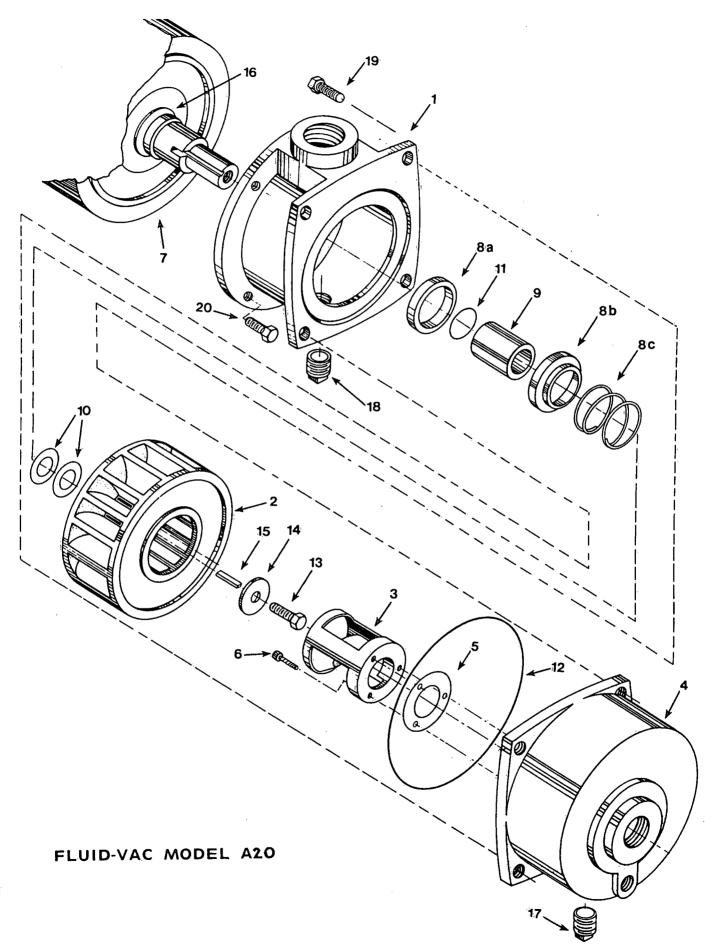
Depending on the heat to be removed and cooling system available on location, Atlantic Fluidics will specify or furnish a heat exchanger to best suit your application. For space-saving and cleaning convenience, Fluid Vac Recirculation packages can be designed with a stainless steel heat exchanger built into the separator tank. In situations where sea water is available for cooling, a separate copper/nickel heat exchanger would be recommended for handling the corrosive salt water.

OTHER ALTERNATIVES

Among the other options for reusing liquid sealant are partial recirculation systems and specially packaged units using sealants other than water (i.e. oil, perchlorethylene, etc.). In a partial recirculation loop, a certain amount of make-up water is fed into the pump to minimize temperature rise yet allow for substantial water savings.

For sealants other than water, be sure to consult Atlantic Fluidics for assistance with both the pump and recirculation sizing.

As one of two American companies specializing in liquid ring pump applications, Atlantic Fluidics invites you to inquire about specific, practical and inexpensive methods for cutting operating costs and for saving that precious natural resource water.



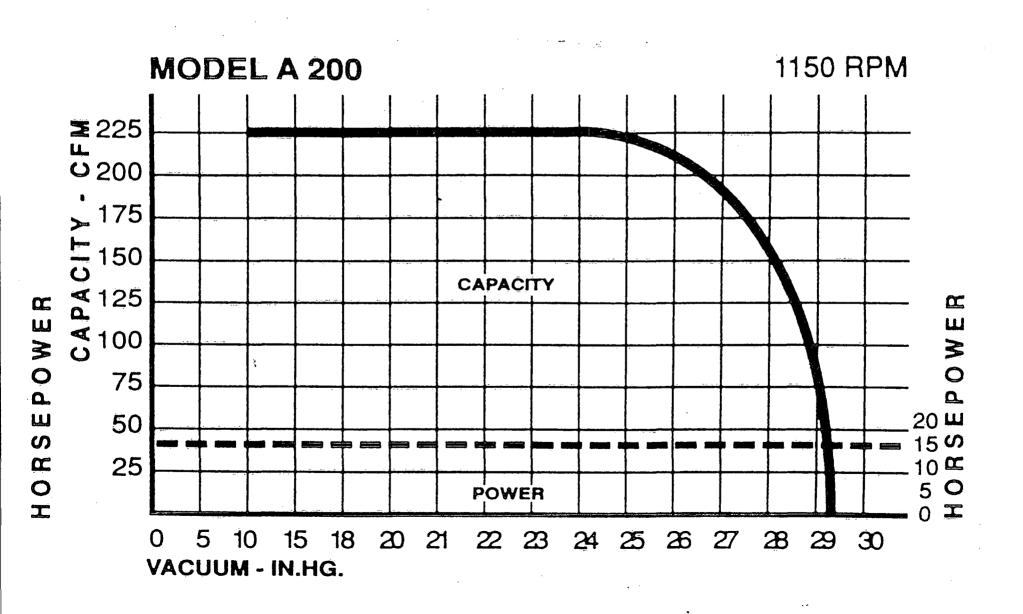
Parts List for Models A5 through A200

Ref.No.	Part		
1	Casing	12	O-Ring, Cover
2	Rotor	13	Lock Bolt
3	Port Cylinder	14	Washer
4	Cover	15	Key
5	Gasket (Port Cylinder)	16	Slinger
6	Cap Screws (Port Cylinder)(3)	17	Drain Plug, Cover
7	Motor	18	Drain Plug, Casing
8	Mechanical Seal Assembly	19	Cover Bolts
	a) Seat b) Seal c) Spring		(4) A10-20 (6) A75-200
9	Shaft Sleeve	20	Casing Bolts (4)
10	Shims (Set)	20a	Casing Nuts
11	O-Ring, Shaft		(4) A75-A200 only

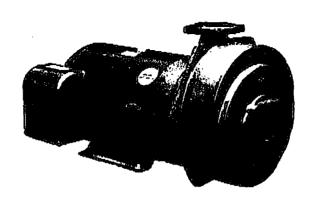
Parts Recommended to Keep on Hand

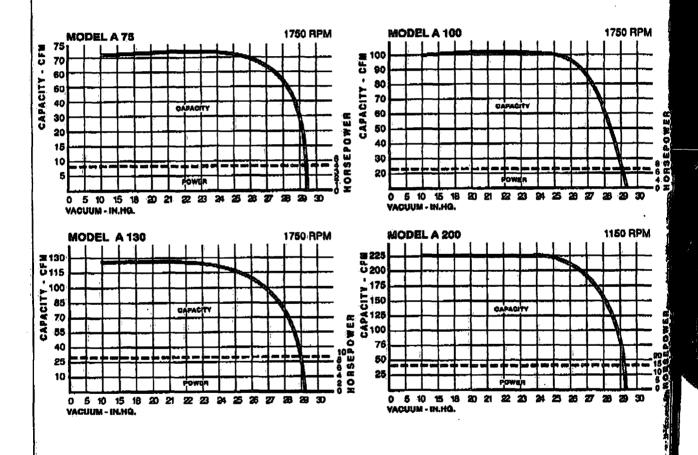
#3	Port Gylinder	Contact:
#5	Gasket (Port Cylinder)	PARTS DEPARTMENT
#8	Mechanical Seal Assembly	Atlantic Fluidics, Inc.
#10	Shims (Set)	21 South Street
#11	O-Ring, Shaft	South Norwalk, CT 06854
#12	O-Ring, Cover	(203) 853-7315
#13	Lock Bolt	Fax (203) 866-8218

Parts can be ordered directly from our Norwalk factory for immediate shipment. All parts are MADE IN AMERICA. We will be happy to assist you with any questions which might arise and for advice on your application.



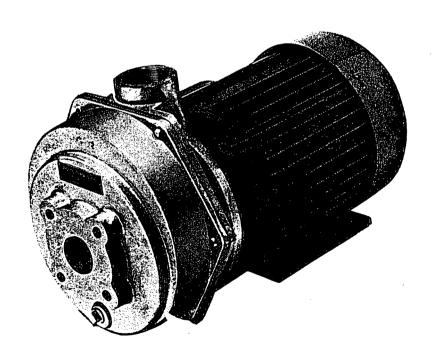
QUALITY AMERICAN PUMPS





atlantic fluidics, inc.

21 South Street So. Norwalk, CT 06854 (203) 853-7315 FAX (203) 866-8218

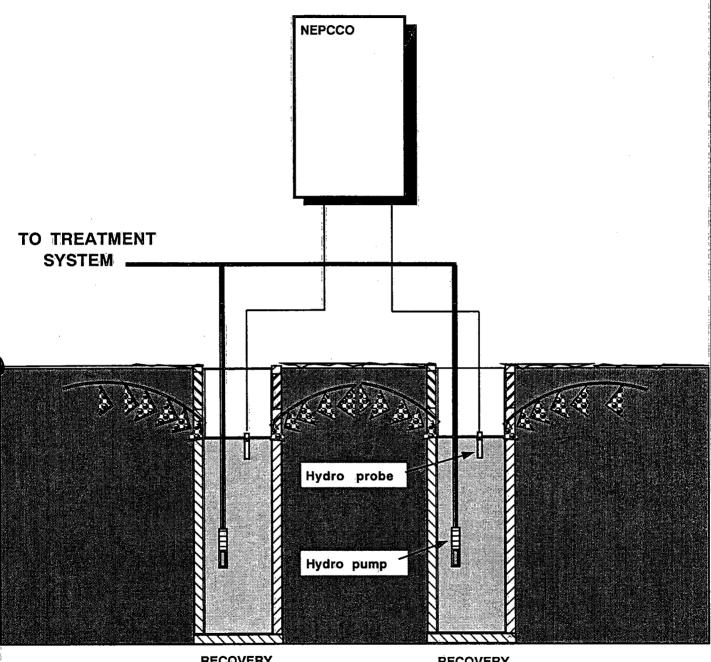


atlantic fluidics, inc. 21 South Street South Norwalk, CT 06854 (203) 853-7315 FAX (203) 866-8218

SECTION 3

CONTROL PANELS

MultiPurge [™]02 KC CONTROLLER



RECOVERY WELL #1

RECOVERY WELL #2

NEPCCO

2140-100 N.E. 36th AVE OCALA, FL 34470 1-800-277-3279

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 - 1.1 BRIEF OVERVIEW OF OPERATION
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LIST OF FIGURES

FIGURE 1 COMPONENT LOCATION CHART

FIGURE 2 HydroPurgeTM PROBE CONNECTIONS

DRAWING ES-4-020-010 HydroPurge™ PROBE & TROUBLESHOOTING

DRAWING ES-4-020-130 GALLERY HI / LO PROBE (OPTIONAL)

NEPCCO

02UL v1.3

02 KC MultiPurgeTM CONTROLLER INSTRUCTIONS

1.0 <u>INTRODUCTION</u>:

- 1.1 <u>BRIEF OVERVIEW OF OPERATION</u>: Nepcco's MultiPurge™ Recovery Systems can accommodate up to eight recovery wells in order to maximize total pumping rate and area of influence. The result can be reduced water treatment costs, and less total time required to bring the project to closure. Savings of 40 to 50 percent in equipment costs over dedicated systems are typical when using two or more recovery wells at an underground spill site.
- In order for the hydro pump to operate, three basic conditions must exist and be transmitted to the Controller via the HydroPurge™ probe. condition is that a liquid must be detected by the hydro probe float. When the float is lifted by a liquid a magnetic switch closure is transmitted through the probe wire to the control panel. This sets condition #1. As the liquid level rises up the probe surface it contacts the * B * sensor (see figure # 3) if the liquid is conductive ie., water, a signal is transmitted to the Controller and sets condition # 2. As the liquid continues to rise, it encounters sensor * A * condition # 3 is set and the hydro pump begins to pump. The HydroPurge™ pump output should be throttled so that its pumping rate is slightly greater than the recharge rate of the well, this insures the pump enough run time to cool between startup intervals. With the pump properly adjusted the water will begin to fall from sensor rod * A * when it does the turn off sequence is initiated and condition #1 is set for the HydroPurge™ pump turn off. The pump does not turn off however, until the water falls below the * B * sensor. At that point the cycling sequence begins again and the desired water drawdown level is achieved and maintained within a 4 inch margin. The float acts as a failsafe. At any time the float is down the pump will not run, this is a measure of protection for the equipment in the event of probe failure.
- 1.3 The MultiPurge™ Model 02KC Controller is a modular design capable of simultaneously controlling **two** HydroPurge™ pump sets. The KC Model also includes a 3 event Failsafe feature that will shut down the Controller in the event of a system failure. Failures such as Sump Level HI-HI, Blower Pressure LO-LO, Gallery HI-HI etc. These Failsafe conditions are transmitted from Sensor switches to the Controller. The Controller detects this contact closure and illuminates the

NEPCCO

corresponding Failsafe indicator lamp and disables the recovery well pumps until Manually Reset.

The following procedures and nomenclature are for the Model 02KC Controller. Other configurations are available at the factory.

2.0 MOUNTING:

2.1 <u>MOUNTING</u> the MultiPurge[™] Controller has been designed for outdoor installation; however, we recommend that some protection from extreme weather conditions be incorporated when possible. Mounting on a wall or other suitable surface is preferred. Although not required, a vertical surface is recommended. The MultiPurge[™] Controller enclosure <u>is not explosion-proof</u> and care should be exercised to keep its mounting location in a <u>non-hazardous</u> location.

3.0 ELECTRICAL CONNECTIONS: (REFER TO FIG. 1 & 2)

- 3.1 <u>GENERAL</u>: Power to and from the MultiPurge™ Controller enclosure is via rain-tight conduit in compliance with the National Electrical Code and local wiring requirements. Access holes for the conduit have not been provided since their location will vary depending on the site layout. In general, power wiring from the main feed should enter the MultiPurge™ Controller enclosure at or near the top, and wires to the pump motors and probes should exit the enclosure at the bottom.
- 3.2 INPUT POWER: 240 volt, 60Hz, 1-phase power for the MultiPurge™ Controller is connected via TB1 at the top of the sub-panel. Provision is made for wire size up to #4 AWG. Input power wires must copper type fused and sized for the combined motor loads. The maximum current for the HydroPurge™ motor is 30 amperes, some motors may require motor starters. For Standard HydroPurge™ small motor loads, 30 amp service is recommended for the MultiPurge™ 02KC Controller.
- 3.3 <u>OUTPUT POWER</u>: 240 volt,60Hz, 1-phase voltage for HydroPurge[™] pumps is available on **TB2** in the middle right hand side of the enclosure (see Fig. 1). Output power must be supplied with copper type power conductors. Power available is normally limited to 15 amps on HydroPurge[™] circuits,. L1 & L2 represent the 240AC volt power leads with an adjacent ground connection for each motor. Power to TB2 is controlled by the low voltage Logic Card and the HydroPurge[™] probes. The Logic Card controls power for HydroPurge[™] pump #1 and #2. The HydroPurge[™] Probes provide the control signals for the Logic Card and therefore, HydroPurge[™]

- pumps #1 and #2.
- 3.4 <u>PROBE INPUTS</u>: The probe inputs are via bulkhead Amphenol connectors located on the bottom of the control panel. The Amphenol connectors are then connected to the control logic via screw terminals at the bottom of the sub-panel TB3. HydroPurge™ probes and or extensions are equipped with an Amphenol connector (instead of spade lugs) for connection convenience. One probe is necessary to control each HydroPurge™ pump. Connections should be by wire color and pin number as shown in the drawing ES-4-020-010.
- 3.5 GALLERY HI/LO (OPTIONAL): The gallery HI LO terminal block is located in the lower right hand side of the control panel. The gallery hi lo probe connects as per the color coded diagram shown by drawing ES-4-020-130. Place the gallery probe in the upper section of the recharge gallery right side up (probe wire up). If the recharge gallery floods, the probe will fail the control panel on the upper float. When the water level falls below the lower float the system will automatically restart. The distance between the HI float and the LO float is approximately 7". If a greater distance between HI and LO is necessary, two probes will be required.

4.0 TROUBLESHOOTING:

- 4.1 <u>FIGURES</u> Figures. 1 shows the component layout and the various component locations. Fig 2 shows the proper connection of HydroPurge™ probes to the terminal block TB-3. The HydroPurge™ probe drawing number ES-4-020-010 can be used to check out the probe by measuring continuity. The (Optional) Gallery HI/LO probe, drawing number ES-4-020-130 shows continuity and color coded terminals.
- 4.2 To verify FAILSAFE operation; Apply power to the Control Panel and simulate a failed condition by manually lifting the probe HI-HI float, the corresponding Red lamp on the front panel should light, and the system should shutdown. This condition should maintain until the failure is removed and the Reset button is pushed. Check each Failsafe channel with its corresponding Sensor. If sensors are not accessible then jumper between sensor and common for each failsafe input at TB-4 (Failsafe Inputs).

COMPONENT LOCATIONS

PUMP SYSTEM	CIRCUIT BREAKER	SOLID STATE RELAYS	LOGIC CARDS	PROBE TERMINALS	POWER OUT TB2	
·						
HYDRO 1	CB1 (15A)	K1 K2	LC1	TB3 (1-4)	1, 2	
HYDRO 2	CB2 (15A)	K3 K4	LC1	TB3 (5-8)	4, 5	
PS1	F1 & F2	-,				

NOTE: HydroPurge™ Circuit breakers are rated at 15 amps typical. Larger circuit breakers, contactors, motor starters etc. can be fitted for the site specific application.

NEPCCO

5.0 START-UP PROCEDURE:

5.1 <u>SET UP</u>: With all wiring completed as described in the previous section and Circuit Breakers #1-#2 "OFF", turn on main power to the MultiPurge™ Controller via power feed breakers or main disconnect. Observe that power supply PS1 Red LED (located inside of the control panel) is "ON".

5.2 Controller CHECK OUT:

5.2.1 Turn CB #1 "ON" and turn front panel HydroPurge™ #1 switch to "MAN" for approximately 2 seconds. The HydroPurge™ pump connected as HydroPurge™ #1 should run for the 2-second interval. CAUTION: Do NOT run the HydroPurge™ motor for more than 2 seconds unless FULLY submerged. Permanent motor and pump damage may occur if the motor is run without proper load and cooling.

If pump runs while in "MAN" mode, proceed to next step. If pump does not run, recheck wiring on TB2, and insure that pump motor runs when powered directly from power feed (bypass MultiPurge™ Controller).

5.2.2 With CB#1 "ON", turn front panel HydroPurge™ #1 switch to "AUTO" position. Slowly immerse in a bucket of water the probe connected to TB3(1-4) Probe #1 (see figure # 2). When water reaches the probe upper sensing rod (A) (shortest 1/4 dia. rod, approximately 3-1/2" from top of probe cage), the green "PUMP ON" light should come on and HydroPurge™ pump #1 should run. Again, observe caution about running motor when not fully submerged. Slowly raise probe out of water. Motor and green "PUMP ON" light should remain on until water level falls below lower sensing rod (B) in the probe (about 7-1/2" from top of the probe). Pump motor and green light should be off at this point.

If procedures check out, continue to next step. If not, check wiring of probe to TB3 and check to insure Logic Card LC1 is fully and properly plugged in. In order to avoid possible damage from static discharge. Logic Cards should never be plugged in or unplugged with power on. Care should be taken not to handle Logic Card connector pins.

- 5.2.3 Using CB#2, Logic Card LC1, HydroPurge[™] Probe #2 connected to TB3(5-8), repeat Steps 5.2.1 and 5.2.2 for checkout of HydroPurge[™] #2.
- 5.3 <u>FUSE CHECKOUT</u>: To check condition of Fuses F1 & F2, observe that the red LED lights on the power supply printed circuit board PS1. If this light is illuminated when the power is on (there is voltage at L1 and L2 of terminal block TB1), and the fuses are OK.

This completes the initial start-up and check-out procedure for the Model 02KC MultiPurge™ Controller panel. You are now ready to install the pumps and probes in the recovery wells.

6.0 INSTALLATION - (READ SECTIONS 1.0 THRU 5.0 FIRST!!)

6.1 All MultiPurge™ Control unit circuit breakers should be in the "OFF" position. Install the HydroPurge™ Probe above the Hydro pump at the depth of the desired cone of depression.

After first lowering the HydroPurge™ Pump into the well (below the desired cone of depression point), lower the probe to the proper depth and fix its position with the supplied cable gripping device .

NOTE: To insure that sediment and sand are not pumped, the HydroPurge™ pump should be positioned a minimum of two feet above the bottom of the well, otherwise, damage may occur that is not covered by warranty.

Switch the circuit breakers to the "ON" position and switch the HOA switch to the on position. The HydroPurge™ Pump should immediately start pumping the well to the desired level. Throttling of the Water Discharge Control is necessary to prevent excessive Hydro pump cycling. The recommended cycling time is approximately 80% ON and 20% OFF.

6.2 02KC MultiPurge™ CONTROLLER PARTS LIST

ITEM #	QTY	PART #	DESCRIPTION
1	4ea	13-0004	4-40 x1 1/4" Stand-Off
2	2 ea	13-0014	4-40 x 3/8" Stand Off
3	2 ea	20-0006	Breaker, Bracket
4	1 ea	20-0005	Failsafe Board
5	2 ea	33-0032	15 amp CKT breaker CB1,CB2
6	2 ea	33-0032	Control switch
7	2 ea	33-0040	Switch contact block
8	2 ea 3 ea	33-0047	Lens Green
9	3 ea	33-0059	Lens Red
10	3 ea	33-0037	Dual-In-Line Relay
11	1 ea	33-0082	Contact Block
12	1 ea	33-0091-01	Reset: Switch
13	1 ea	33-0091-02	Enclosure W/Back plate
14	5 ea	33-0095	Lamp
15	5 ea	33-0056	Lamp holder
16		33-0006	Electronic switching relays
17	4 ea 2 ea	33-0000	Fuse holder
18	2 ea	33-0010	
19	2 ea 1 ea	33-0045	1 amp fuse Connector, Logic Card
20	1 ea	33-0034	Cable Clamp
		34-0038-01	•
21	1 ea		Terminal strip TB3-TB-5
22	1 ea.	34-0032	Terminal strip TB2
23	3 ea	34-0034	Terminal strip TB1
24	1 ea	34-0030	Mounting Rail (6")
25	1 ea	34-0030	Mounting Rail (3")
26	1 ea	34-0033	Barrier
27	4 ea	34-0035	End Stop
28	A/R	34-0013	Red #6 spade lug
29	A/R	34-0027	Blue #8 spade lug
30	1 ea	50-0061	5-volt power supply 2 amp
31	1 ea	50-0018-01	Logic board LC1
32	1 ea	50-0059	Lamp driver board L.D.B.9

NEPCCO 02UL v1.3

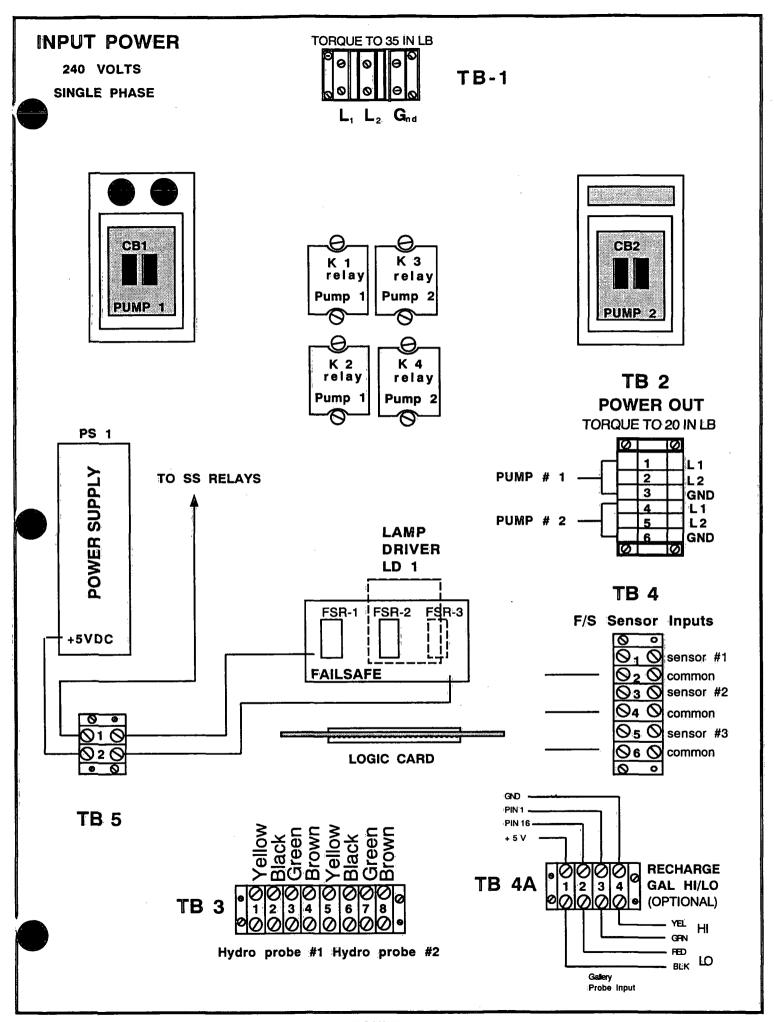
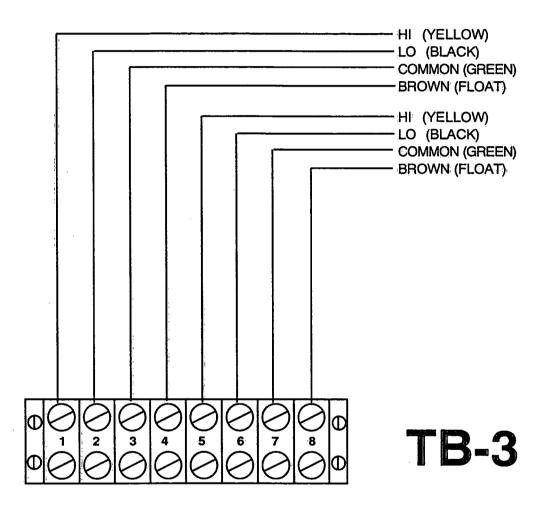


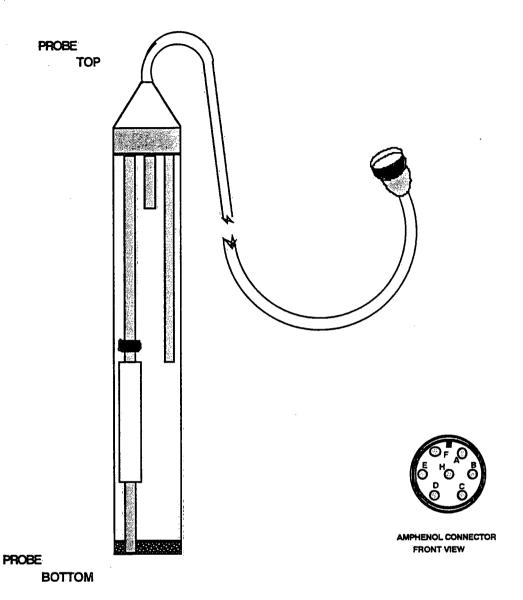
FIGURE 1

HYDRO PROBE CONNECTIONS



Probe#1 Probe #2
To Amphenol Connectors

STANDARD HydroPurge™ PROBE PART # 50-0004



NOTES:

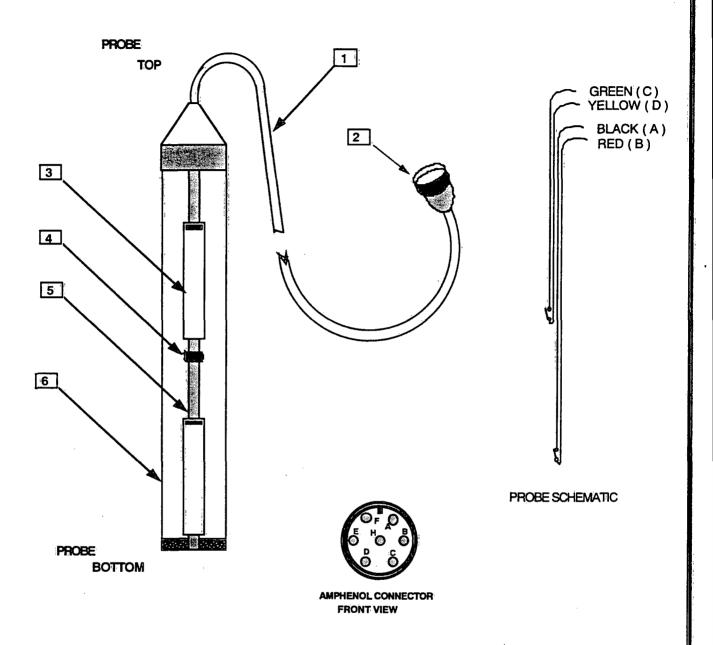
- A.) Amphenol pin (A) = 2" sensor rod "A" Yellow wire
- B.) Amphenol pin (B) = 5.5" sensor rod "B" Black wire
- C.) Amphenol pin (C) = 10" sensor rod "C" Green wire
- D.) With the float in the up position there should be continuity between the green wire (C) and the brown wire (D)
- E.) Probe diameter 2 1/8" O.D.

ITEMS LIST:

- 1.) 25 ft Tefzel insulated probe cable P/N 17-0007
- 2.) 7 pin Amphenol connector P/N 35-0008 or spade lug connectors P/N 34-0013
- 3.) Polyurethane float assembly P/N 20-0037
- 4.) S.S. float stop collar w/set screw P/N 13-0008
- 5.) S.S. probe cage 12" P/N 20-0008 BLUE

Drawn by Pat, Date 9/93		Title STANDARD HydroPurge™ PROBE	NEPCCO		
Chkd by 1197	Rev	probe # 50 - 0004			
Approved Eng	Approved QA	Drawing # ES - 4 - 020 - 010	Project:No	Customer No	
W9	Tates Stan Nivi	Customer			

N/W RECHARGE GALLERY HI/LO PROBE PART # 50-0005



NOTES:

- A.) With the BOTTOM float in the up position, continuity between pin A or (BLACK) and pin B or (RED).
- B.) With the TOP float in the up position, continuity between pin C or (GREEN) and pin D or (YELLOW).
- C.) Standard probe diameter 1 7/16" O.D.

ITEMS LIST:

- 1.) 2 ft Tefzel insulated probe cable P/N 17-0007
- 2.) 7 pin Amphenol connector P/N 35-0008 or spade lug connectors P/N 34-0013
- 3.) Polyurethane float assembly P/N 20-0037
- 4.) S.S. float stop collar w/set screw P/N 13-0008
- 5.) S.S. sensor rod "C" P/N 50-0056A (modified)
- 6.) S.S. N/W probe cage 12" P/N 20-0008 YELLOW

Drawn by WC Date 10/93	Title RECHARGE GALLERY HILO PROBE	NEPCCO		
Chkd by May Rev	part # 50-0005			
Approved Eng Approved QA	Drawing # ES-4-020-130	Project No	Customer No.	
Tellis hackir (VE)	Customer			



Instruction Bulletin No. 111970

65800 Series

Single Channel Zener Barrier

INSTALLATION AND MAINTENANCE

GEMS 65800 Series, shunt diode, safety barriers are one channel devices which pass a unidirectional signal (D.C.) and limit the energy to a level that cannot ignite an explosive atmosphere. Approvals include FM, UL, CSA.

Installation Requirements

<u>Location</u>: Barriers must be installed and grouped in a non-hazardous location. If necessary to locate in a hazardous area, barriers must be mounted in a suitable enclosure which, along with its installation, must be suitable for the location.

Environment: The operating temperature range of these barriers is -40°F to +140°F. They should be mounted in a clean, dry environment and well ventilated, so that the maximum temperature is not exceeded. If an enclosure is used, it must be suitable for the location. Earth Connection: The bracket on which the barrier is mounted must be connected to an earth ground. Grounding should be adequate for conduction of line-generated fault currents and should have an impedance of less than one ohm. See Figs. 1 and 2.

Safe Area Apparatus: Safe area apparatus must not generate, or be connected to, sources having voltages greater than 250 Vrms or VDC.

Installation

It is expected that the installation will be in accordance with ISA RP-12.6, NEC Chapters 5 and 7 and FM Standards Approval. The following specific points should be kept in mind:

- 1. Check that the barrier is of specified type and polarity.
- 2. For multiple barrier installation, the barrier's safe area sides should face one side of the enclosure and the I.S. sides should face the opposite side (Fig 1). Wiring must be channeled and segregated as shown, so that no mis-wiring can occur during servicing, testing or replacement.
- 3. Connect the hazardous area equipment to terminals marked "3" and "2" (Fig. 3). Hazardous area field wiring will store energy due to distributed capacitance and inductance in proportion to its length. Common, commercially available signal wire may be used; provided the capacitance and inductance are below the following maximum values:

Installation (Cont.)

Example: Typical values of capacitance for a twisted pair of copper wires is between 20 and 60 pf per foot. Using the maximum value of 60 pf/ft., inductance of a typical twisted pair is between 0.10 and 0.20 uh/ft. The maximum values of capacitance/or inductance should be used to determine field wiring length.

GEMS P/N	Rated Volt.	GEMS P/N	Rated Volt.	Group	Parellel Capac uf	Series Induct mH
111950 111952 111954 111956	+15 +20 +24 +30	111951 111953 111955 111957	-15 -20 -24 -30	A,B,C, D,E,G	0.32 0.18 0.12 0.07	2.0 4.1 3.0 1.8
113000 114072 114074 114175	+30 +24 +18 +27	114071 114073 114075 114176	-30 -24 -18 -27	C, D, E, G	0.20 0.33 0.72 0.24	3.0 3.1 3.6 3.3

Signal Return Barriers

114162 +18 114163 -18 A, B, C, 114166 +30 114167 -30 A, B, C, D, E, G	0.23 0.11 0.07	.35 .35 .35
---	----------------------	-------------------

Safety depends on earth continuity. The resistance to earth ground must be less than 1 ohm.

Inspection and Test of Barrier

A routine inspection should be made at intervals of not more than two years. Harsh locations should be inspected more frequently to:

- 1. Check integrity of earth grounding (Less than one ohm).
- 2. Check unit labeling for legibility.
- 3. Check all interconnections for good electrical connection.

CAUTION

Never conduct tests while circuit is active. Use of instruments between input and output will bypass barrier.

Testing:

- 1. All testing is to be done with circuit inactive and all but earth grounding disconnected.
- 2. With a suitable ohmmeter (resolution to 1 ohm), measure the resistance from input (1) to output (3). The total resistance readings shown in the chart on the next page indicate a good unit.

GEMS P/N	Rated Volt.	GEMS P/N	Rated Volt.	Total Resist. Ohms**	Limit Resist. Ohms**	Fuse Rating ma	Max. Voc	ISC ma	
111950	+15	111951	-15	183	153	250	17.3	112.8	
111952	+20	111953	-20	303	273	125	22.2	81.2	
111954	+24	111955	-24	390	360	62	26.2	72.7	
111956	+30	111957	-30	750	720	62	33.1	46.0	
113000	+30	114071	-30	303	273	250	36.1	132.3	
114072	+24	114073	-24	234	204	62	26.2	123.2	
114074	+18	114075	-18	183	153	125	19.9	130	
114175	+27	114176	-27	276	246	62	29.1	118.3	
Signal Return Barriers									

		114163 114165			30 30	125 62	19.9 26.2	
114166	+30	114167	-30	33.9	30	250	36.1	0

^{**}All resistance values are ±5%

Fig. 1: Multiple Barrier Mounting

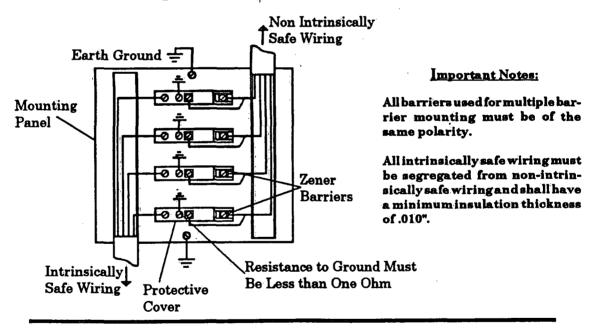


Fig. 2: Optional Mounting Clip (P/N 113530)

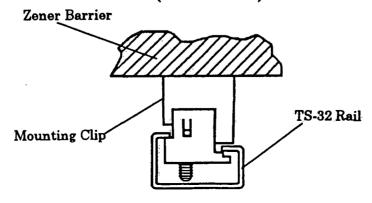


Fig. 3: Installation Diagram

Note: Positive signal channel shown. Sensor switch may be any non-voltage producing, essentially resistive device; containing no energy storing components. Flow and level switches, temperature switches, pressure switches or resistive transducers or transmitters are typical.

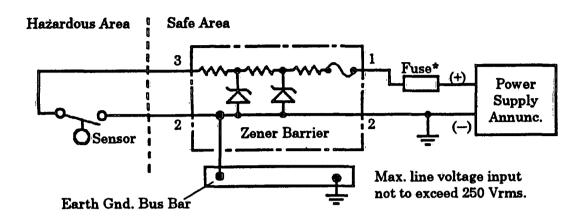
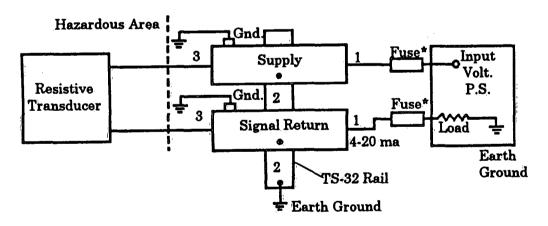


Fig. 4:
Supply and Signal Return Barrier Installation (4-20 ma
Transducer with Both Leads Floating & Neg. Signal Common)

Note: Redundant grounding required by CSA.



*Little fuse type 3AG or equal (optional). External fuses are recommended to protect barrier from incorrect wiring or equipment faults at start-up.



Imo Industries Inc.

Gems Sensors Division

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TEL: 203-747-3000 FAX: 203-747-4244

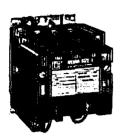
POWER OUTPUT DEVICES

FULL VOLTAGE CONTACTORS & STARTERS — NEMA

CLASS 8502, 8536

AC MAGNETIC CONTACTORS Class 8502

GENERAL INFORMATION — Class 8502 Type S magnetic contactors are used to switch heating loads, capacitors, transformers, and



Type SCO2 Size 1, 3 Pole Contactor

electric motors where overload protection is separately provided. Class 8502 contactors are available in NEMA Sizes 00 - 7. Type S contactors are designed for operation at 600 Volts AC, 50 - 60 Hertz.

HOLDING CIRCUIT CONTACT — A normally open holding circuit contact for three wire control is provided on all contactors as standard. Sizes 00 - 2 contactors use a Class 9999 SX11 auxiliary contact as the holding circuit contact. Sizes 3 - 7 contactors use a Class 9999 SX6 auxiliary contact as the holding circuit contact.

cuit contact. See Class 9999, page 11-225 for the holding circuit contact electrical ratings. On Size 00 - 1 single phase contactors, a power pole is used as the holding circuit contact and therefore has the same rating as the power contacts.

ENCLOSURES — Class 8502 magnetic contactors are available in the following enclosures:

NEMA Type 1 General Purpose

NEMA Type 4 & 4X Watertight and Dusttight Stainless Steel NEMA Type 4X Watertight, Dusttight, and Corrosion Resistant Glass-Polyester

NEMA Type 7 & 9 Bolted and Spin-Top for Hazardous Locations NEMA Type 12 Dusttight and Driptight for Industrial Use

The NEMA Type 4 & 4X stainless steel enclosure (Sizes 0 - 5) has a brushed finish. For an electropolished finish, specify Form G16 and add 15% to the price of the standard device.

Also, NEMA Type 12 devices are available UL listed for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations. Request Form G21, no additional charge.

Separate enclosures are available, see Class 9991, pages 11-212-11-219.

AC MAGNETIC STARTERS Class 8536

GENERAL INFORMATION — Class 8536 Type S magnetic starters are used for full voltage starting and stopping AC squirrel cage motors. Motor overload protection is provided by melting alloy type thermal overload relays. Class 8536 starters are available in NEMA Sizes 00 - 7. Type S starters are designed for operation at 600 Volts AC, 50 - 60 Hertz.

HOLDING CIRCUIT CONTACT — A normally open holding circuit contact for three wire control is provided on all contactors as standard. Sizes 00 - 2 contactors use a Class 9999 SX11 auxiliary contact as the holding circuit contact. Sizes 3 - 7 contactors use a

Class 9999 SX6 auxiliary contact as the holding circuit contact. See Class 9999, page 11-225 for the holding circuit contact electrical ratings.

OVERLOAD RELAYS — Class 8536 Type S Size 00 - 6 starters are provided with a melting alloy thermal overload relay as standard, interchangeable thermal units are available in standard trip Sizes 00 - 6, quick trip Sizes 00 - 4, and slow trip Sizes 00 - 3. Single phase starters use one thermal unit, three phase starters use three thermal units.



SCO3 Size 1, 3;Pole Starter

Class 8536 Size 7 starters are provided

with a solid state Motor System Monitor whose features include: Class 20 ambient compensated overload protection, phase failure and underload protection, and manual or automatic reset.

Bimetallic overload relays are also available for Sizes 0-6. Ambient compensated and non-compensated versions are supplied with manual or automatic reset, trip current adjustment, and an alarm contact on Sizes 0-2. For additional application information see Class 9065 section, pages 11-206-11-207. To order a Type S starter with a bimetallic overload relay, see Factory Modifications (Forms) on pages 11-230-11-237.

ENCLOSURES — Class 8536 magnetic starters are available in the following enclosures:

NEMA Type 1 General Purpose Enclosure

NEMA Type 3R Rainproof, Sleet Resistant for Outdoor Use

NEMA Type 4 & 4X Watertight and Dusttight

NEMA Type 4X Watertight, Dusttight, and Corrosion Resistant Glass-Polyester

NEMA Type 7 & 9 Bolted and Spin-Top for Hazardous Locations NEMA Type 9 Bolted for Hazardous Locations

NEMA Type 12 Dusttight and Driptight for Industrial Use

The NEMA Type 4 & 4X stainless steel enclosure (Sizes 0 - 5) has a brushed finish. For an electropolished finish, specify Form G16 and add 15% to the price of the standard device.

Also, NEMA Type 12 devices are available UL listed for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations. Specify Form G21, no additional charge.

Separate enclosures are available, see Class 9991, pages 11-212-11-219.

COIL VOLTAGES — AC coils are available for application on 50 - 60 Hertz. NEMA Sizes 00 - 5 are supplied with coils that are designed to operate satisfactorily on line voltages of 85% - 110% of rated voltage. NEMA Size 6 and 7 contactors are supplied with a DC coil operated by a solid state rectifier circuit that is powered by an AC source.

Please note that **Voltage Codes** have been added to the Type designations in order to improve customer service. It is necessary to include the Voltage Code when ordering contactors and starters. Also, 120 Volt Polyphase contactors and starters will be wired for separate control.

AUXILIARY CONTACTS — Additional auxiliary contacts may be added to Type S contactors. See page 11-27 for maximum number of auxiliary units and Form designations for factory installed auxiliary contacts. See Class 9999. page 11-225 for auxiliary contact kits for field installation.

TYPE S ACCESSORIES — Additional accessories such as power poles, pneumatic timer attachments, and cover mounted control stations are available as factory or field modifications. For factory modifications (Forms), see pages 11-230-11-237. For field modification kits, see Class 9999, pages 11-224-11-229.



Single Phase Control Boxes

Identification Of Cables When Color Code Is Missing (FOR SINGLE PHASE 3-WIRE UNITS ONLY)

Procedure

If the colors on the individual drop cables cannot be found; that is, if no colored threads are visible and no identifying ribs are present and the leads cannot be identified, proceed as follows:

- Disconnect all three drop cables from the control box. For temporary identification, tie tags to them and give each a number — 1, 2 and 3.
- With an ohmmeter, measure the following three values of "unknown" ohms. Then match the item with the "unknown" item on the left with the "known" item on the right to determine the color of cables 1, 2 and 3.

"Unknown"

"Known"

Cable 1 to cable 2 (---ohms)
Cable 1 to cable 3 (---ohms)
Cable 2 to cable 3 (---ohms)

Lowest-Black to yellow Intermed.-Red to yellow Highest-Black to red

3. Note that "yellow" cable is that used to obtain lowest and

intermediate readings and that "red" cable is that used to obtain highest and intermediate readings.

Example

Suppose that the ohm reading were:

- 1 to 2 measures 6 omms (highest)
- 1 to 3 measures 4 ohms (intermediate)
- 2 to 3 measures 2 ohms (lowest)

The actual ohm values are not important. What is important is which reading is highest, intermediate and lowest. This method will work regardless of the actual value of the ohm readings.

Cable 3 was used to obtain both the intermediate and lowest ohm reading. This is the yellow cable.

Cable 1 is the cable used to obtain the intermediate and highest ohm readings. This is the red cable.

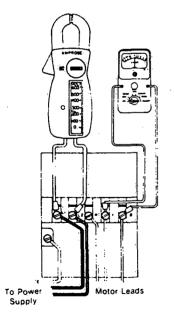
Meter Connections for Motor Testing

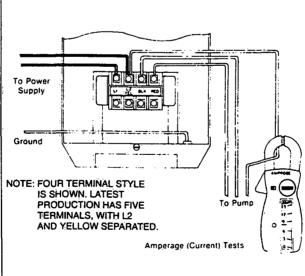
Figure 7
Q.D. Control Box

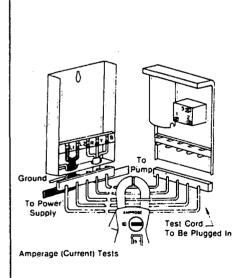
Figure 8
Non Q.D. Terminal
Board

Figure 9

Q.D. Control Box







CHECKING MOTOR WITH "Q.D." TYPE CONTROL BOX

- 1. Remove cover to break all motor connection.
 - CAUTION L₁ and L₂ are still connected to power.
- 2. To check VOLTAGE: Use voltmeter on L₁ and L₂ as shown in Figure 7.
- 3. To check CURRENT (amps):

- (a) Connect test cord (150961 901) between control box cover and wall plate (See Fig. 9).
- (b) Use hook-on ammeter as shown.

OR — If test cord is not available, without removing control box cover, use hook-on ammeter at fuse box or pressure switch.

Single Phase Control Boxes

Checking and Repairing Procedures

CAUTION TURN POWER OFF AND DISCHARGE CAPACITORS BEFORE USING OHMMETER

Test or Procedure	Non Q.D. Control Box	Q:D. Control Box
A. General Procedures	Disconnect line. Inspect for damaged or burned parts, loose connections, etc. Check for misconnections against diagram in control box. If problem has not been found, check motor per Table 1 and control box as indicated below.	Remove cover to disconnect motor line. CAUTION L ₁ and L ₂ are still connected to power source. Same. Same. Same, except motor leads are disconnected when cover is removed.
B. Use of Ohmmeter	Ohmmeter such as Simpson Model #372 or #260, Triplett Model #630 or 2: Whenever scales are changed, short ohmmeter leads and "zero balance"	
C. Ground (Insulation Resistance) Test	Ohmmeter Setting: Highest scale (usually R x 100K or R x 10,000). Terminal Connections: One chmmeter lead to "Ground" terminal on control box and touch other lead to each of the other terminals on terminal board. Ohmmeter Reading: Pointer should remain at (∞) and not deflect.	Same. One ohmmeter lead to frame of control box lid and other to terminals on control box lid. Same.
D. Overload Protector	1. Ohmmeter Setting: R x 1. 2. Terminal Connections: Connect one ohmmeter lead to Terminal Black and other lead to: (a) Terminal L ₁ in four-terminal boxes. (b) Terminal L ₂ in five-terminal boxes. 3. Ohmmeter Reading: Should be 0 to 0.5 ohms maximum.	Same. Terminal Connections: Connect ohmmeter leads between Terminals Black and line terminal with blue wire. Same.
E. Capacitor Tests	 Ohmmeter Setting: R x 1,000. Terminal Connections: One ohmmeter lead to relay terminal #1 and other to black terminal on terminal board. Ohmmeter Reading: Pointer should swing toward "zero" and "float" back to (∞), open if it does: not move from (∞). If reading is not as above, disconnect capacitor from overload and test ear 	
F. Relay Coll Test (potential relays only)	1. Ohmmeter Setting: R x 1,000 (or R x 100). 2. Terminal Connections: #5 and #2 on Relay. 3. Ohmmeter Reading: For 115 Volt Boxes G.E. 7-1.8 (700-1800 ohms) Cardinal .5585 (550- 850 ohms)	For 230 Volt Boxes 4.5 - 7.0 (4500-7000 ohms) 2.8 - 4.2 (2800-4200 ohms)
G. Relay Contact Test (potential relays only)	Most cases of inoperative relay contacts can be detected as follows: 1. Ohmmeter Setting: R.x. 1. 2. Terminal Connections: Terminal #1 and Terminal #2 on Relay. 3. Ohmmeter Reading: Should be "zero". Note: This test verifies "making" of contacts. If it is desired to test "opening" a. Connect control box components in control box as indicated on diagram in control box cover. b. Connect three leads from motor of correct rating to control box terminal board. c. Connect power source voltage to L1 and L2. d. Current in:Red lead should momentarily be a high value — then drop (within one second) to values on Page 2.	and closing of contacts: Same for all, except attach five conductor test cord to connect control box lid to wall mounted terminals for reading current in red lead. Check current as shown on page 2.
H. Relay Coil Test (current relays only)		Ohmmeter Setting: R x 1. Terminal Connections: #1 and #3. Ohmmeter Reading: Less than 1 ohm.
I. Relay Contact Test (current-relays only)		 Ohmmeter Setting: R:x 1000. Terminal Connections: #2 and #4. Ohmmeter Reading: Infinity (∞) Relay contact test verifies that contacts are open. To check closing of contacts, attach 5 conductor test cord to connect control box lid to wall mounted terminals. While applying power, monitor current in Red lead, current should be a high value then drop within one second to zero amps.
J. Triac Test (solid state switch only)		Ohmmeter Setting: R x 1000 Connect the leads to "R" (start) terminal and to orange lead terminal on start switch. Ohmmeter Reading: Infinity.
K. Coil Test (solid state switch only)		 Ohmmeter Setting: R x 1. Connect leads to "Y" (common) and L2 terminal: Ohmmeter Reading: Less than 1 ohm. To verify proper operation of switch with motor connected. Attach 5 conductor test cord to connect control box lid to wall mounted terminals. While applying power, monitor current in red lead, current should be a high value then drop within one second to zero amps.

Control Box Parts List

Q.D. CONTROL BOX COMPONENTS TABLE 16

		Potential			Super Stainless	MT3 Motors (3)
НР	Volt (1)	or Current Relay:(1)(4)	Solid State (1) Switch	Capacitor (2)(5)	Capacitor- Overload Ass'y (1)	Overtoad
1/3	115	155 031 101 or 155 252 103	152 138 905	275 461 122 or 275 464 125 110v, 159-191 mfd.	151 033 973	151 496 973
	230	155 031 102 or 155 252 101	152 138 901	275 461 123 or 275 464 126 220v, 43-53 mfd.	151 033 974	151 496 974
1/2	115	155 031 101 or 155 252 105	152 138 906	275 461 101 or 275 464 101 110v, 250-300 mfd.	151 033 975	151 496 975
7,2	230	155 031 102 or 155 252 102	152 138 902	275 461 108 or 275 464 105 220v, 59-71 mfd.	151 033 976	151 496 976
3/4	230	155 031 102 or 155 252 103	152 138 903	275 461 106 or 275 464 118 220v, 86-103 mfd.	151 033 978	151 496 978
1 ,	230	155 031 102 or 155 252 104	152 138 904	275 461 107 or 275 464 113 220v, 105-126 mfd.	151 033 979	151 496 979
11/2	230	155 031 102		275 461 107 220v, 105-126 mfd.	151 033 980	151 496 977
				Run Capacitor 275 835 102 440v, 5 mfd.		

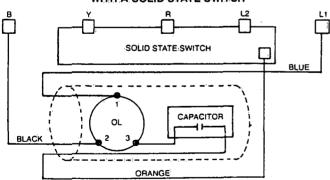
FOOTNOTES:

(1) Control boxes supplied with voltage relays are designed to operate on nominal 230v systems. For 208v systems or where line voltage is between 200v and 210v substitute 208v relay part no. 155 031 103 and cable 2 sizes larger.

Control boxes supplied with solid state switch are designed to operate on nominal 230v systems. For 208v systems or where line voltage is between 200v and 210v use cable 2 sizes larger. Voltage relay kit 155 031 903 may be used to replace current relays used on 208v systems.

REPLACEMENT INSTRUCTIONS

TO REPLACE A RELAY (VOLTAGE OR CURRENT) WITH A SOLID STATE SWITCH



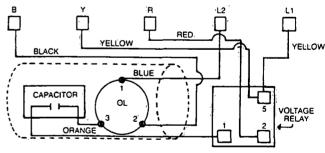
CONTROL BOX WIRING DIAGRAM WITH SOLID STATE SWITCH

- 1. Disconnect power to control box.
- Remove control box cover. Disconnect all leads from the relay and terminal strip. Discard all loose leads.
- Plug solid state switch into center terminals (Y, R, L2) on the side of the terminal strip nearest to the capacitor.
- 4. Connect all three leads from capacitor as follows:
 - A. Blue lead to the "L1" terminal.
 - B. Orange lead to the terminal on the solid state switch.
 - C. Black lead to the "B" main terminal.
- 5. Replace cover on the control box and reconnect the power.

NOTE: Do not add running capacitors to standard production ½ through 1 HP control boxes which use current relays or solid state starting switches. Adding capacitors will cause failures. If the control box is converted to use a voltage relay, the specified running capacitance can be added.

- (2) Capacitors and capacitor-overload ass'y, are provided in plastic cases. Two inch diameter assemblies may be substituted for old style 1¾" dia. assemblies by bending control box terminal bracket.
- (3) Super stainless control box parts may be used on MT & MT-3 motors.
- (4) Voltage relay kits, 115 volt, 155 031 901 and 230 volt, 155 031 902 will replace either current or voltage relays, or solid state switch
- (5) Capacitor's with part number prefix 275461 are designed for use with overload's.

TO REPLACE A SOLID STATE SWITCH WITH A VOLTAGE RELAY.



CONTROL BOX WIRING DIAGRAM WITH VOLTAGE RELAY

- 1. Disconnect power to the control box.
- Remove the control box cover. Disconnect orange lead from the solid state switch. Disconnect the blue lead from the "L1" terminal.
- Remove solid state switch from the three center terminals. Install voltage relay next to capacitor.
- 4. Connect orange and blue leads from capacitor as follows:
 - A. Orange lead to relay terminal #1.
 - B. Blue lead to "L2" terminal.
 - C: Black lead stays on "B" (main) terminal.
- Make a red jumper wire and connect it from "R" (start) terminal to relay terminal #2.
- Make two yellow jumper wires. Connect one jumper from "Y" (common) terminal to relay terminal #5. Connect other jumper from relay terminal #5 to "L1" terminal.
- 7. Replace cover on the control box and reconnect power.

Note: Voltage relay kits include necessary jumper wires and mounting hardware.

MAINTENANCE

INTEGRAL HORSEPOWER CONTROL BOX COMPONENTS • 230 VOLT TABLE 17

Motor Rating	Control ·	i '	Capacitors (4)			Overload (2)	Relay (10)	Contactor
HP-Dia.	Model No.			Part No.	Part No.	Part No.		
11/2-4"	282 1001 201	275 464 106 S.	145 - 1,75	220	1	275 411 106 S	155 031 102	
	000 0001 000	275 466 101 R (6)	10 104 - 126	370 220	1 1	275 411 103 R 151 496 920	155 031 102	
	282 3001 200	275 461 107 S 275 466 101 R (6)	104 - 126	370		155 033 925 (3)	135 03:1 102	
	282 3007 202 or	275 461 107 S	104 - 126	220	1	151 496 922	155 031 102	
	282 3007 102	275 479 102 R (6)	10	370	1	151 033 946 (3)		
	282 3007 203 or	275 461 107 S	104 - 126	220	1	151 496 922	155 031 102	j
	282 3007 103	155 328 102 R	10	370	1-1-	151 033 946 (3)	1	
2 - 4"	282 1011 201	275 468 115 S (6)	189 - 227	220 370	1 1	275 411 107 S 275 411 102 R	155 031 102	
A	282 3011 201	275 466 102 R (6) 275 464 113 S	• 15 104 - 126	220	1 1	275 411 102 N	155 031 102	
	202 0011 201	275 466 108 R (6)	20	370	1 1	275 411 112 R		
	282 3018 202	275 464 113 S	104 - 126	220	1	275 411 107 S	155 031 102	
	000 0040 000	275 479 105 R (6)	20	370	1 1	275 411 112 R	155 001 100	
-	282 3018 203 or 282 3018 103	275 464 113 S 155 328 103 R	104 - 126 20	220 370	1 1	275 411 107 S 275 411 112 R	155 031 102	
3 -4"		275 464 106 S	145 - 175	220	2	275 411 108 S	155 031 102	
:5-4	282 1022 201	275:466:101 R (6)	10	370	2	275 406 107 R	133 03/1102	
,	282 3021 201	275 464 106 S	145 - 175	220	1	275 411 108 S	155 031 102	
		275 475 101 R (6)	35	370	1	275 406 120 R		
	282 3028 202	275 463 111 S	208 - 250	220	1	275 411 108 S	155 031 102	
	282 3028 203 or	275 481 102 R (6) 275 463 111 S	35 208 - 250	370 220	1	275 406 120 R 275 411 108 S	155 031 102	
	282 3028 103	155 327 102 R	35	370	li	275 406 120 R	130 001 102	
5 - 4"	282 1032 201	275 468 116 S (7)	108 - 130	330	2	275 411 109 S (6)	155 031 102 (9)	
		275 466 102 R (6)	15	370	4	275 406 103 R		
	282 1132 201	275 468 105 S (6)	144 - 176	330	1.7	275 411 102 S	155 031 102 (9)	
	000 4400 000	275 466 102 R (6)	15	370	4	275 406 103 R	155 001 100 (0)	
	282 1139 202	275 468 118 S 275 479 103 R (6)	216 - 259 15	330 370	1 4	275 411 102 S 275 406 103 R	155 031 102 (9)	1.00
50 - 5 LAW	282 1139 203 or	275 468 118 S	216 - 259	330	1	275 411 102 S	155 031 102 (9)	
	282 1139 003	155 327 101 R	30	370	2	275 406 103 R		
	282 1139 303 or	275 468 118 S	216 - 259	330	1	275 411 102 S	155 031 102 (9)	155 325 1
	282 1139 103	155 327 101 R	30	370	2	275 406 103 R		<u> </u>
5 - 6"	282 2002 201	275 468 116 S (8)	108 - 136	330	4	155 083 103 (6)	155 031 102 (9)	
	Prior to 1975 282 2002 201	275 466 102 R (6)	15 130 - 154	370 330	2 2	155 083 103 (6)	155 031 102 (9)	
	202:2002:201	275 468 117 S 275 466 102 R (6)	15	370	2	155 085 105 (0)	133 031 102 (3)	
	282 2009 202	275 468 117 S	130 - 154	330	2	155 249 102	155 031 601	
		275 479 103 R (6)	15	370	2			
	282 2009 203	275 468 117 S	130 - 154	330	2	155 249 102	155 031 601	
	282 2009 303	155 327 101 R	30 130 154	370 330	1 2	155 249 102	155 031 601	155 325 1
	202-2009-303	275 468 117 S 155 327 101 R	30	370	1 1	155 249 102	133 031 001	100 020 1
71/2 - 6"	282 2012 201	275 468 117 S	130 - 154	330	4	155 083 104 (6)	155 031 102 (9)	
. 72 - 0	Prior to 1975	275 466 102 R (6)	15	370	3	133 000 104 (0)	135 551 102 (5)	
	282 2012 201	275 468 117 S	130 - 154	330	3	155 083 104 (6)	155 031 102 (9)	
		275 466 102 R (6)	15	370	3			
	282 2019 202	275 468 117 S	130 - 154	330 370	3	155 249 101	155 031 601	
	282 2019 203	275 479 103 R (6) 275 468 117 S	15 130 - 154	330	3	155 249 101	155 031 601	
	- W 1-42 3 45 46 1 1	155 327 101 R	30	370	1			
		155 328 101 R	15	370	1			
	282 2019 303	275 468 117 S	130 - 154	330	3	155 249 101	155 031 601	155 326 10
3.54		155 327 101 R	30	370	1			I I .
		155 328 101 R	120 154	37.0	1 1			<u> </u>
10 - 6"	282 2029 202	275 468 117 S 275 479 103 R (6)	130 - 154 15	330 370	- 4· 5	155 249 103	155 031 601 (5)	
	282 2029 203	275 468 117 S	130 - 154	330	4	155 249 103	155 031 601 (5)	
		155 327 101 R	30	370	2			
	*	155 328 101 R	15	370	1 1			
İ	282 2029 303	275 468 117 S	130 - 154	330	4	155 249 103	155 031 601 (5)	455 000 -
		155 327 101 R	30	370 370	2			155 326 1
15 C"	202 2020 202	155 328 101 R	15 270 - 324		+	155,400,100	155 021 102	155 225 4
15 - 6"	282 2039 203	275 468 119 S 155 327 101 R	30	330 370	2	155 409 102	155 031 102	155 325 1
15 - 6"	282 2039 303	275 468 119 S	270 - 324	330	2	155 409 102	155 031 102	155 429 1
	202 2003 303	155 327 101 R	30	370	4	100 405 102	133 001 102	155 325 1
		155 328 101 R	15	370	l i	1	1	ı . ,

FOOTNOTES:

(1) Lightning arrestor for 150 814 902 suitable for all control boxes.
(2) These overload mounting kits required on control box date:code B71 or (2) These overload mounting kits require prior.

1½:HP - 305 050 901

2 HP - 305 051 901

5 Capacitor and overload ass'y.
(4) Run cap or main wdg. protector (R) Start cap or start wdg. protector (S)

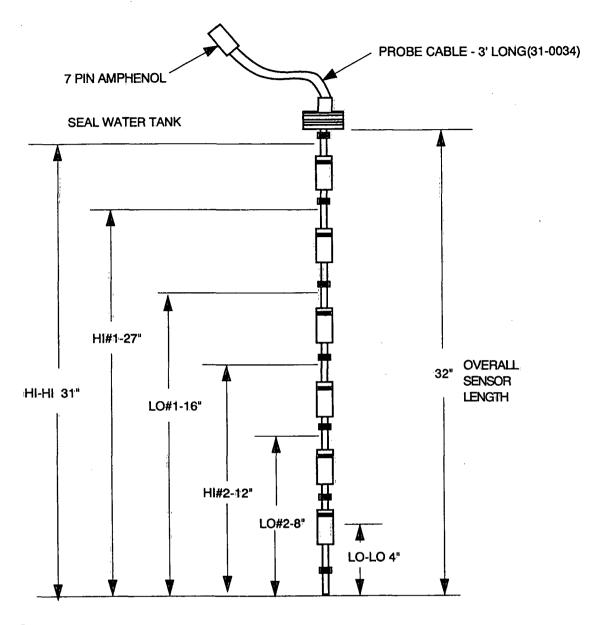
3 HP - 305 052 901 5 HP - 305 053 901

Zirequired.
These parts may be replaced as follows:
Old New Old New
155:083 103 - 305 070 902 275:468 115 - 275 468 118
155:083 104 - 305 070 901 275 475 101 - 155 327 102

Old	New	Old	New
275 411	109 - 275 411 102	275 479	102 - 155 328 102
275 465	115 - 175 464 113	275 479	103 - 155 328 101
275 466	101 - 155 328 102	275 479	105 - 155 328 103
275 466	102 - 155 328 101	275 481	101 - 155 327 102
275 466	108 - 155 328 103	275 481	102 - 155 327 102

(7) Replace 2 of 275 468 116 with 1 of 275 468 118. (8) Replace 4 of 275 468 116 with 2 of 275 468 118. (9) Replace with 155 031 601.

(9) Hepiace with 155 031 001.
(10) For 208v systems or where line voltage is between 200v;and 210 volts special low voltage relays are required. Use relay part 155:031 103 in place of part 155:031 102 and use relay part 155:031 602 in place of part 155:031 601. Also use cable 2 sizes larger.



NOTES:

A.) HI-HI	AMPHENOL PIN "E", RED WIRE
B.) HI #1	AMPHENOL PIN "A", YELLOW WIRE
C.) LO #1	AMPHENOL PIN "B", BLACK WIRE
D.) HI #2	AMPHENOL PIN "F" , ORANGE WIRE
E.) LO #2	AMPHENOL PIN "H", GREEN WIRE
F.) LO-LO	AMPHENOL PIN "D", BROWN WIRE N.C.
G) COMMON	AMPHENOL PIN "C" BARE WIRE

M)				
Drawn by AJF	Date 5/31/94	Title HydroPurge™ MULTILEVEL PROBE	NEP	CCO
Chkd & front	Rev	FOR AIR WATER SEPARATOR TANK	NEP	
	Approved QA	Drawing No ES-4-020-160	Project No	Customer No
	46. D. D. S. J.	Customer IT PITTSBURGH	729008EH	519063

SECTION 4

TRANSFER PUMP



GENERAL PUMP MFG, INC.

INSTALLATION AND OPERATION INSTRUCTIONS KEEP FOR FUTURE REFERENCE

Although this is a centrifugal pump and can handle a small amount of foreign matter with the water it is explicitly understood that the manufacturer is not responsible for any difficulty or expense caused by reason of foreign material—such as sand—being produced with the water pumped.

When corresponding always give the following data which should be copied from the motor and pump name plates **before** installation.

MOTOR SERIAL NO.	H.P
PUMP SERIAL NO	MODEL NO.
VOLTS A.C. A	MPS PHASE
FUSE SIZEAN	MPS CYCLES
INSTALLER'S NAME	
INSTALLER'S ADDRESS	
DATE OF INSTALLATION _	

DO NOT CONNECT TO ANY OTHER POWER SUPPLY

* INSTALLATION AND OPERATION INSTRUCTIONS

PLEASE CAREFULLY OBSERVE THE FOLLOWING STEPS WHEN MAKING YOUR INSTALLATION. ONLY QUALIFIED AND AUTHORIZED INSTALLERS SHOULD MAKE THE INSTALLATION.

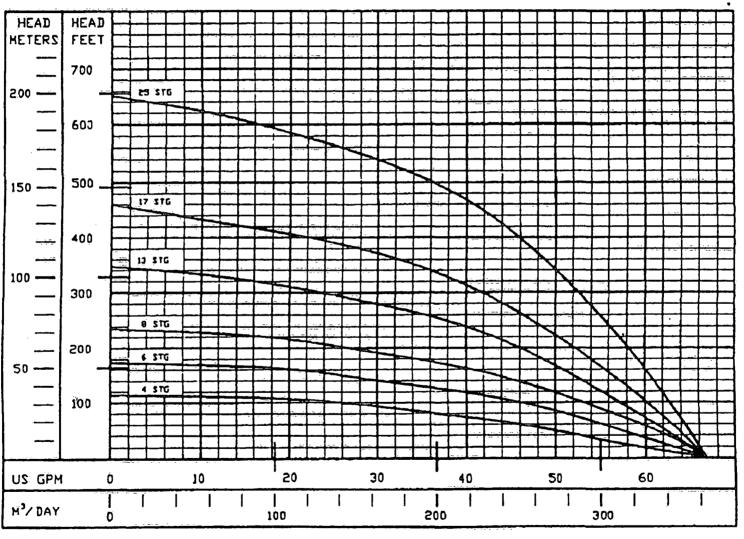
- 1. Splice Cable to motor leads following instructions on pages 4-5. SPLICING TAPE SHOULD BE STRETCHED TIGHT WHEN APPLIED.
- 2. Test Unit—When testing the GPM Pump the unit MUST BE IMMERSED IN WATER. DO NOT RUNTHE PUMPING UNIT DRY FOR ANY LENGTH OF TIME.
- 3. Install Pump—Use proper size galvanized iron pipe, plastic pipe, steel tubing or Type "K" copper tubing. Consult catalog for proper pipe sizes. PIPE THREAD COMPOUND SHOULD BE APPLIED TO ALL MALE JOINTS INCLUDING CHECK VALVE THREADS. Check valve is installed hand tight for easy removal to apply thread compound.
- 4. Cable—Only Cable supplied by manufacturer should be used. Fasten cable to discharge pipe every 10 feet with suitable length of AWG#12 or AWG#10 insulated copper wire. See cable selection charges, pages 21-22, for correct cable size. THE CABLE SHOULD NEVER BE ALLOWED TO SUPPORT THE WEIGHT OF THE UNIT.
- 5. Bleeder Orifice Whenever pneumatic pressure tank is used requiring an air charging system, the bleeder orifice MUST BE INSTALLED AT LEAST 10 FEET, BUT NO MORE THAN 35 FEET, BELOW SNIFTER VALVE REGARDLESS OF PIPE SIZE USED. For large tank sizes add pipe between bleeder orifice and snifter valve as follows: For each 40 gallons of tank capacity, 1" pipe, 5 feet —11/4" pipe, 3 feet —11/2" pipe, 2 feet —2" pipe, 1 foot. DO NOT USE BLEEDER ORIFICE WITH PERMANENTLY PRESSURED SYSTEMS.
- 6. Check Valve—Snifter Valve—Install in discharge line as close to well as possible. Snifter valve may be installed if needed on pump side of check valve in tapped hole providing valve is located in well pit or pump house. See "Typical Installation and Air Charging Systems," pages 6-11.

DO NOT USE SNIFTER VALVE WITH PERMANENTLY PRESSURED SYSTEMS.

- 7. Safety Valve —Install near pressure tank. It may be plumbed to drain if desired.
- 8. Pressure Tank —May be installed in any convenient place, but must be protected from freezing. When selecting pressure tank, allow 10 gallons minimum tank capacity for each 1 GPM pump capacity.
- 9. Air Volume Control—Install in tapped hole in pressure tank (see illustrations, pages 7-11). Pressure gauge is installed in tapped hole in Air Volume Control. DO NOT USE AIR VOLUME CONTROL WITH PERMANENTLY PRESSURED SYSTEMS.
- 10. Accessories —Install sanitary well seal, well vent, electrical conduit and surface piping according to local governing codes.
- 11. Pressure Switch—MUST BE INSTALLED ON PRESSURE TANK OR WITHIN 5-FEET OF TANK ON INLET SIDE. Should pressure switch be installed at location other than on tank, a minimum 4-inch riser nipple must be used to avoid "surge cycling" (rapid on and off). PRESSURE SWITCH MUST BE USED AS PILOT FOR MAGNETIC STARTER. See wiring diagrams, pages 12-20.
- 12. Control—Non-fusible disconnect switch with manual reset thermal overload relay is used for 1/3 to 1 h.p., single phase. Other single phase and three phase units use motor control which includes magnetic starter. See wiring diagrams, pages 12-20. "Use with approved motor control that matches motor input in full load amperes."
- 13. Magnetic Starter or Pumping Plant Panel—Only starting equipment supplied by the manufacturer may be used. MUST BE INSTALLED ON ALL UNITS OR WARRANTY WILL NOT APPLY.
- 14. B/W-LH Electric Control—May be installed on low capacity wells to protect pump from damage due to "Pump Off." See writing instructions in control package.
- 15. B/W-RH Electric Control—May be installed on open storage tank to provide automatic operation. See wiring instructions in control package.
- 16. U.S.G. Liquid Level Control may be installed on low capacity wells. This control operates from line pressure and is therefore helpful in corrosive fluid applications. See wiring instructions in control package.

45 GPM

PUMP PERFORMANCE CURVE 60 HZ, 3450 RPM



CAPACITY

SECTION 5

INSTRUMENTATION

PRIMARY ON/OFF CONTROL

Previously, "TC" (Cycle Time) and "P" Proportional Band had to be set to "0" in the Tuning Parameters to enable On/Off control. Now, the user need only set "P" to "0" to enable On/Off control of the primary Output (Heat or Cool) eliminating one step.

AUTO TUNING

Auto Tuning is now possible in both Direct (Cool) and Reverse (Heat) control. See Manual 955-301A for the proper implementation of this feature.

OUTPUT ON SENSOR BREAK

How the controller output(s) react to a sensor break (burn-out) depends upon the direction of the break and the user's selection in Configuration Parameter P-n1. Below is a chart comparing the older and newer unit's sensor break display.

	DIRECTION	DISPLAY	<u>ALARM</u>
NEW	Upper	"טטטטי	High
	Lower	"LLLL"	Low
OLD	Upper	"UUUU"	High
	Lower	"UUUU"	High

INTERNAL SWITCH TO SELECT INPUT

Two units are available, a TC/RTD unit and a Voltage/Current unit (NOT interchangeable). To change to an RTD input from a TC input, an internal jumper is used. Previously, an internal switch was used. To implement these changes, please contact the factory for instructions.

ANALOG CURRENT OUTPUT WIRING

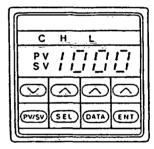
The standard manual does not contain connections for the optional analog output. This output is wired to terminals 4 (+) and 5 (-).



SUPPLEMENTAL MANUAL

> 955-301A Addenda #2 3891

MODEL 1400 TEMPERATURE CONTROLLER



Updates & New Features

UPDATED TUNING PARAMETERS

SV	=	Setpoint or Setting Value
p	=	Proportional Band
ī	=	Integrating (Reset) Time
d	=	Derivative (Rate) Time
ĄL	=	Alarm Low Value
AH	=	Alarm High Value
TC	=	Cycle Time
HyS	=	Hysteresis
°Srr	=	Setpoint Ramp Rate
•At	=	Auto Tuning
Loc	Ė	Keypad Lockout

New or enhanced feature described in this addenda

UPDATED CONFIGURATION PARAMETERS

P-n1	=	Control Action
P-n2	=	Input Type
P-df	=	Digital Filtering
P-SL	=	Lower Span Limit
P-SU	=	Upper Span Limit
P-Ab	=	Alarm Selection
P-An	=	Alarm Deadband
P-dp	=	Decimal Point
P-48	=	(Constant) 3
*rS	=	Rate of SP Ramp Enable
PVOF	=	Process Variable Offset
SVOF	=	Setpoint Offset
P-F	=	Degrees F/C Select

New Feature

Note: Configuration Parameter P-C7 no longer appears. Disregard the comments in the standard manual for this parameter.

RATE OF RAMP TO SETPOINT

This feature allows user control over the rate that the PV ascends (heats) or descends (cools) to the setpoint. This is a one-time ramp that is in effect only after a power up condition. Any subsequent setpoint change will not be affected by the Rate of Ramp feature. To enable this feature, access Configuration Parameter "rS" and enter a "1" (a "9" disables it). To set in the number of degrees per minute, access Tuning Parameter "Srr" and enter the desired data (decimals are valid). The green LED will flash as the PV approaches the Setpoint and subsequently turns off when the setpoint is reached. For example, with the controller monitoring 70° F and the setpoint set to 310, the calculation becomes: 310 - 70 = 240. 240 divided by the desired time to ramp (say, 60 minutes) equals 4. Therefore, 4 degrees per minute would be entered.

FEATURES

INPUT SELECTION: J, K, R. B, T OR S TC 1000 IEC OR JIS Pt RTD 1-SVDC or 4-20 mADC

OUTPUT SELECTION: 3A @ 220VAC SPDT EMR 4-20 MADC into 6000

AUTO TUNE:

Auto Tune on operator command PID values displayed Manual override all values

DISPLAY:

4-digit red LED .32 inch high. 5 colored LED status indicators. 8 tactile feedback operation keys. Programmable keypad lockout.

CASE

Drip proof washable bezel.
Compact 1/16 DIN less than 4" deep including socket.
Self locking mounting flange.
Panel or surface mount using standard 8 or 11 pin socket.

POWER:

Wide range 85 to 265 VAC. Power consumption 10 VA. 1500 VAC Dielectric Test.

ALARM:

14 Alarm type selections. 1A @ 220V "NO" contact.

RECALIBRATION

The controller generates an internal digital number during factory input calibration that is stored in permanent memory. The controller continually recalibrates itself based on that fixed digital value. There is no drift due to temperature or other effects. For this reason, recalibration in the field should not be required.

SERVICING

If repair is required, the complete instrument should be adequately packed. Do not send the electronic assembly without its case. Include a brief note describing the observed problem and ship prepaid to:

> LFE Instruments Repair Department 11655 Chillicothe Road Chesterland, Ohio 44026-1994 (216) 729-1681



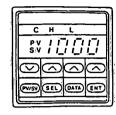
Instruments Division A Mark IV Company

INSTALLATION AND OPERATION

PRICE \$6.00

955-301A 1690

MODEL 1400 TEMPERATURE CONTROLLER



INSTALLATION RECONFIGURATION TUNING OPERATION

INTRODUCTION

This compact, economical temperature controller is microprocessor based and incorporates the latest in surface mount and CMOS technology. Exceptional performance features make this controller the equal of larger, more expensive units.

SPECIFICATIONS

Accuracy: ± 0.5% ± 1 digit

Display: 4 digit, 7 segment LED

5 LED status indicators
Alarm: (Optional) 1 Ampere EMR

Ambient: -10 to 50°C Humidity: 90% RH or less

Storage: -20 to 60°C Power: 80 to 265 VAC

10 VA

1500 VAC

50 MΩ

P = 0 to 999.9% span.
I = 0 to 3600 seconds.
D = 0 to 3600 seconds.
AUTO TUNING - standard
Cycle Time = 1 to 150 seconds.
Anti-reset windup - standard.

T/C burn-out protection - standard.

Note: On power-up, there is a 5 second delay for self-check before the display illuminates.

IDENTIFICATION

This case label identifies the controller by part number.

Part Number:

T0-1234-0000

1=T/C	1=HEAT EMR 2=COOL EMR	0=NONE	4 SOCKET 0=NONE PANEL 1=8 PIN
4=1-5VDC	3=HEAT 4-20 4=COOL 4-20 5=24VDC Tr	OmADC igger	3=11 PIN SURFACE 2=8 PIN 4=11 PIN

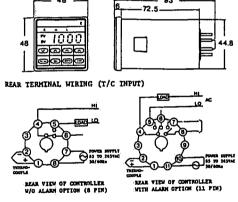
CAUTION: DO NOT OPEN CONTROLLER

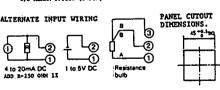
There are no serviceable parts. The only reason to open the controller is to switch between T/C and RTD inputs.

The electronic assembly is held in place by tabs molded into the rear black assembly. You must force the case over these tabs using a small flat screw driver. There are two slots, right and left side, of the black assembly for this purpose. DO NOT PRY the electronics out at the front bezel.

CAUTION: CONTAINS CMOS COMPONENTS. OBSERVE CMOS HANDLING PRECAUTIONS.

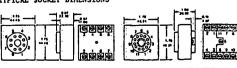
When the electronics is removed; the switch or jumper can be found on the small circuit board facing the rear.





TYPICAL SOCKET DIMENSIONS

INSTALLATION



8 PIN FOR PANEL HOURT 11 PIN FOR PANEL HOURS SURFACE HOURT 8 6 11 PIN SOCKETS ALSO AVAILABLE

OPERATOR CONTROLS

There are 5 indicator LEDs:

C	=	Control output ON
H	=	HI alarm ON
L	= 1	LO alarm ON
PV	=	PV being displayed
SV	=	SV being displayed

There are 4 function keys:

(PV/SV)	=	Selects PV or SV to be displayed
(SEL)	=	Advances parameter display selection
(DATA)	=	Displays existing parameter
(ENT)	=	Enters new parameter value into memory

There are 4 arrow keys:

W	=	Address and increment the digit(s) directly above the key.
		The two left hand digits are incremented by the left most
		up arrow key
(V)	=	Decrement digit(s) that is flashing

CHANGING A SELECTION

Changing a displayed parameter selection is a quick and easy routine. The parameter of interest is first displayed and then its value. The value is changed one digit at a time and then entered. The same routine is used to change any parameter.

To display a TUNING PARAMETER, press the (SEL) key. Note that the display does not advance until the key is released. To display a CONFIGURATION PARAMETER, press and hold (SEL) for 10 seconds, then use (SEL) in the normal manner. Press and hold (SEL) for 10 seconds to switch back to TUNING.

RULES FOR CHANGING A SELECTION

- Press (SEL) until the parameter of interest is 1. displayed.
- Press (DATA) to display existing selection. 3. Press (N) under the digit to be changed.
- Digit will flash.
- Press (/) under digit to increment value or (V) to decrement value.

 Change each digit individually except for the
- two left hand digits which function together.
- 6. When the new value is displayed, press (ENT). The next parameter will automatically be displayed and the selection will be stored.

TUNING PARAMETERS

The TUNING PARAMETERS establish the tuning and setpoint values for the specific application to be controlled. These parameters include, in order.

SV Setpoint or Setting Value

P Proportional Band

Integrating (reset) Time

D Derivative (Rate) Time

LO Alarm Value AL.

AΗ HI Alarm Value

TC Time Cycle

HYS Hysteresis (Deadband)

AT Auto Tuning

LOC Keypad Lockout

For complete details on these parameters, see the reverse side of this manual.

EXAMPLE #1

High Alarm (AH) is set for 1200. Change AH to a value of 952.

- AH is one of the TUNING PARAMETERS so press the (SEL) key repeatedly until AH is displayed.
- Press (DATA) to display the existing value to
- To change 1200 to 952, each digit is changed individually as follows:

1

Press indicated arrow key once

	2 /\			Press indicated arrow key once and indicated digit will digit will flash.
	2 /\			Press indicated (\bigwedge) key twice to display 2.
-	2 /\	-		Press indicated arrow key once and indicated digit will flash.
	2 /\	_		Press indicated (\(\sigma\) key 5 times to display 5.
-	2 A	-		Press indicated arrow key once and two digits will flash.
0	9	5	2	Press indicated (\(\iam\) kev 3 times

to change 12 to 9.

Press (ENT) key to load new value.

 $\Lambda \Lambda \Lambda$

CONFIGURATION PARAMETERS

The CONFIGURATION PARAMETERS establish the controller operation for a specific application. These parameters include, in order:

P-n1 = Control Action

Input Type P-n2

Digital Filtering P-dF

P-SL Lower Span Limit

P-SU Upper Span Limit

Alarm Deadband

P-Ab

P-dP

P-C7

P-AN

P-48 DO NOT CHANGE (3)

Decimal Point

Alarm Selection

PV Offset **PVOF**

SVOF = SV Offset

P-F Unit °F or °C

for complete details on these parameters, see reverse side of this manual.

DO NOT CHANGE (100)

EXAMPLE #2

Low Limit (P-SL) is set for -200. Change (P-SL) to a value of +50.

- P-SL is one of the CONFIGURATION PARAMETERS, so press and hold (SEL) key for 10 seconds.
- P-n1 will display when (SEL) is released. Then press (SEL) repeatedly until P-SL is displayed.
- Press (DATA) to display the existing value of -
- To change -200 to 50, each digit is changed individually as follows:

- 2 0 0 \/ A /\ /\		-	Press indicated arrow key once and indicated digit will flash.			
_	0	0	0	Press (V) key 2 times	to	

display 0. $\mathbf{A} \vee \mathbf{A} \vee \mathbf{A}$ 0 0 0 Press indicated arrow key once

Press (/) key 5 times to display 50. 5 0 **∨ ∧ ▲ ∧**

and indicated digit will flash.

5. Press (ENI) key to load new value.

\/ \/ **A** \/\

NOTE: In going - to + or + to -, you must stop at 000 as part of the routine. Notice that the first negative number is -1999.

TUNING PARAMETERS

The TUNING PARAMETERS establish the tuning and setpoint values for the specific application to be controlled. All TUNING PARAMETER selections listed below appear in the sequence selections listed below appear in the sequence shown when the (SEL) key is pressed. Change any previously selected value using the "CHANGING A SELECTION" routine explained in this manual unless the keypad is LOCKED. (See LOCat the bottom of this column.) Scanning the TUNING PARAMETERS has no effect on control. Press the (SEL) key to advance the display. CONFIGURATION displays appear on the display, press and hold (SEL) for 10 seconds to display TUNING PARAMETERS.

NOTE: You must press the (ENI) key after each selection to store new values and selections.

- SV SETTING VALUE is the setpoint or selected value. SV can be displayed at any time by pressing the (PV/SV) key. If SV is displayed (SV indicator ON), pressing the (PV/SV) key will display the PROCESS VALUE (PV indicator ON). Press (PV/SV) to switch between SV and PV.
- PROPORTIONAL BAND will be automatically determined by AUTO TUNE or can be manually set from 0.0 to 999.9% of span at this display.. Use "CHANGING A SPLECTION" routine to change "P".

NOTE: With ON/OFF (2-position) control action, set P=0. Deadband hysteresis (HYS) for ON/OFF control is selected below.

- INTEGRATING TIME will be automatically determined by AUTO TUNE or can be manually set from 0 to 3600 seconds at this display. Setting i=0 inhibits integral action. Use "CHANGING A SELECTION" routine to change "i".
- DERIVATIVE TIME will be automatically determined by AUTO TUNE or can be manually set from 0 to 3600 seconds at this display. Setting d=0 inhibits derivative action. Use "CHANGING A SELECTION" routine to change "d".

If the optional alarm is included, ALARM output action and deadband (hysteresis) is selected in the CONFIGURATION PARAMETERS. When selected, the alarm values are set using the next two displays.

AL Low Alarm setpoint value.

AH High Alarm setpoint value.

Set the desired alarm setpoint(s) using "CHANGING A SPLECTION" routine for AL and/or AHL

NOTE: Alarm deadband P-An acts as shown:

CONFIGURATION PARAMETERS

The CONFIGURATION PARAMETERS establish the controller operation for the specific application. All CONFIGURATION PARAMETER selections listed below appear in the sequence shown when the (SEL) key is pressed. Change any previously selected value using the "CHANGE A SPLECTION" routine explained in this manual unless the keypad is LOCKED. (See LOC under TUNING PARAMETERS). Scanning the CONFIGURATION PARAMETERS has no effect on control: Press the (SEL) key to advance the display.

To access the CONFIGURATION PARAMETERS, repeatedly press the (SEL) key until "P" is displayed. Then press and hold the (SEL) key for 10 seconds. "P-a1" will appear on the display. If it does not, repeat the sequence. You can shift between TUNING and CONFIGURATION parameters at any parameter display by pressing and holding the (SPL) key for 10 seconds.

P-n1 From the table below, select the desired output type by entering its display value using the "CHANGING A SELECTION" routine described in this manual.

DISP.	CONTROL	OUTPUT ON
VALUE	ACTION	SENSOR BREAK
0	HEAT (Reverse)	0% (OFF)
1	HEAT (reverse)	100% (ON)
16	COOL (Direct)	0% (OFF)
17	COOL (Direct)	100% (ON)

On burn-out with "0" or "16" selected, the display will show "UUUU" and the "H" indicator will come on. On burn-out with "1" or "17" selected, the display will show "LLLL" and the "L" indicator will come on. On either burn-out, the alarm (option) will trip.

P-n2 Two separate units, not inter-changeable, are available with respect to inputs:

1. A thermocouple/RTD input controller.

- 2. A voltage/current input controller.

An internal circuit board mounted switch changes the first unit between T/C and RTD inputs. See the installation section for details on access-ing this switch. The voltage/current selection requires a rear terminal addition or deletion of a 249Ω , 1% resistor. See the installation section for details.

A parameter selection is also required at Pn2 to specify the input. Use the "CHANGING A SELECTION routine to specify the input

INPUT	DISPLAY	INPUT DISPLAY
TYPE	VALUE	TYPE VALUE
THERM	OCOUPLE	1000 RTD
J	2	Pt(JIS) 0
K	3	Pt(IEC/DIN) 1
R	4	•
В.	5	VOLTAGE/CURRENT
S	6	1-5 VDC 31
Ţ	7	4-20 mADC 31
E	8	•

NOTE: AFTER ANY INPUT SELEC-TION CHANGE, CYCLE THE AC POWER ON AND OFF

P-dP **DIGITAL FILTERING** minimizes noise pickup at the cost of response time. Select a digital filtering constant from 0 to 201 using the "CHANGING A SELECTION" routine.

ALARM SELECTION (continued) P-Ab

Process alarm setpoints are set as exact values. Deviation alarms are set as offset values and can be either positive or negative with respect to SV. In each case, the AL and AH exact or offset values are independently set as part of the TUNING PARAMETERS

Deviation Alarm Example:

Process Alarm Example:

LOWER LIMIT HOLD feature inhibits the low alarm on start-up until PV exceeds the low alarm setpoint.

Specify the desired alarm action from the list below by entering the alarm selection value using the "CHANGING A SELECTION" routine. Do not enter illegal values.

0 = No Alarm

Deviation Alarms:

5 = AL only 10 = AH only

15 = AL and AH

69 = AL with HOLD

79 = AL with HOLD and AH

Process Alarms:

1 = AL only

2 = AH only

3 = AL and AH

65 = AL with HOLD

67 = AL with HOLD and AH

Deviation/Process mix:

7 = AL dev. and AH proc.

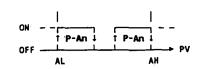
11 = AL proc. and AH dev.

71 = AL dev. w/HOLD and

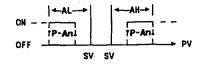
AH proc.

75 = AL proc. w/HOLD and AH dev.

P-An Alarm deadband can be selected from 0 to 255 display units.



DEVIATION ALARM



TC TIME CYCLE is the ON/OFF control action cycle time and can be set from 1 to 150 seconds using the "CHANGING A SPLECTION" routine.

NOTE: Controllers with 4-20mA output <u>must</u> have TC=0.

HYS HYSTERESIS (deadband) for ON/OFF (2-position) control can be set from 0.0 to 20.0% of span. This deadband is centered about the SV.

AT AUTO TUNING automatically establishes the PID values when initiated.
Before auto tuning, SV must be greater
than PV. To initiate AUTO TUNING,
set AT display value=1. "P" must=0.
For PID control, set HYS=0.

NOTE: When AUTO TUNING is in-itiated, a dot will flash in the LSB position (right end digit). When the dot goes OFF, AUTO TUNING is complete.

IMPORTANT: Depending on the application, auto tuning may take considerable time.

LOC Three keypad LOCKOUT selections are available.

0 = No keypad lockout.

1 = All settings locked out.

2 = All settings except SV are locked out.

NOTE: When selection 1 or 2 is made, all parameters can still be viewed but not changed. The LOC display is always available to be changed.

CAUTION: DO NOT SET IN ILLEGAL SELECTION VALUES.

Press (SEL) to review all TUNING PARAM-

Press (PV/SV) to return to the principle display.

a 60% response is equal to one-half of the selected Digital Filtering value.

P-SL Lower Span Limit.

P-SU Upper Span Limit.

The operating span is the range between the selected lower and upper limits set as P-SL (Lower Limit) and P-SU (Upper Limit). Using the "CHANGING A SHIPCTION" routine, set both lower and upper limits within the allowable limits listed below.

INPUT	MIN/MAX SPAN
_ 	0/1000°C 32/1832°F
K	0/1200°C 32/2192°F
R	0/1600°C 32/2912°F
В	0/1800°C 32/3272°F
T	-200/400°C -328/752°F
Ε	0/800°C 32/1472°F
S	0/1700°C 32/2912°F
Pt-100Ω	-140/400°C 32/752°F
Voltage	-1999/3000
Current	-1999/3000

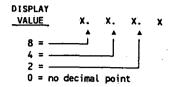
OVER/UNDER SPAN DISPLAYS

		_] =	PV above span
<u> </u>	_[PV under span

OFF AI T P-An I PV

NOTE: Alarm Value decimal point will automatically conform.

P-dPSelect the decimal point location as follows:



NOTE: Selecting a new decimal point position also requires resetting all parameters affected such as P-SL, P-SU, SV, AL and AH

P-48 DO NOT CHANGE (Set at 3)

P-C7 DO NOT CHANGE (Set at 100)

PVOF PV offset is available and can be set from
-1999 to +2000 using the "CHANGING
A SPLECTION" routine.

SVOF SV offset is available and can be set from -1999 to +2000 using the "CHANGING A SPLECTION" routine.

P-F Units of °F or °C is selected at this display using the "CHANGING A SPLECTION" routine.

0 = degrees C 1 = degrees F

NOTE: Three front keypad decals are provided with each controller for indicating the display units on the front of the instrument. If the display units are changed, the front decal must also be changed. You must also change all parameters affected by the change in units.

P-Ab ALARM SELECTION

There are 14 selections of alarm action. The alarm, when provided, can be a process or deviation alarm, can have two independent setpoints (AL and AH) and can have combination action as shown.

AL = Low Alarm Value

AH = High Alarm Value

WARRANTY

LFE Instruments warrants this instrument against defects in material and workmanship for a period of 18 months from date of shipment. LFE Instrument's obligation under this warranty is expressly limited to the repair or replacement at its factory provided that (a) LFE Instruments is promptly notified in writing by the Buyer upon his discovery of a defect, (b) upon receipt of written authorization from LFE Instruments said defective equipment is returned as directed, transportation charges prepaid by the Buyer, and (c) LFE Instrument's examination of such equipment discloses to its satisfaction that the defect exists and was not caused by negligence, misuse, improper installation, accident or unauthorized repair or alteration by the customer.

This warranty does not cover mechanical parts failing from normal usage nor does it cover limited life electronic components which deteriorate with age.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE WHETHER TO THE ORIGINAL PURCHASER OR TO ANY OTHER PERSON. LFE INSTRUMENTS SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES OF ANY KIND.

The aforementioned provisions do not extend the original warranty period of any article which has been either repaired or replaces by LFE Instruments Division. LFE Instruments shall not be bound by any terms, conditions, representations or warranties, express or implied, which are not stated herein.



TACO FLO-SETTER



- Direct Reading Flow Meter
- Balancing Valve
- Shut-Off Valve
- Nickle Plated Brass
- Compact In-Line Design
- Low Pressure Drop



Submittal Data Information

401-020

FLO-SETTER

SUPERSEDES: 401-020—December 18, 1987

EFFECTIVE: JUNE 1, 1992

APPLICATION

The Flo-Setter is a combination direct reading flow meter, and adjustable ball valve for balancing and shut-off. This valve is suitable for commercial hot and chilled water closed loop applications, domestic water circulation, and solar systems.

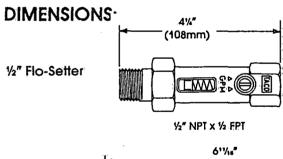
VALVE

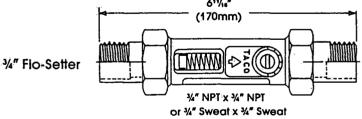
PRODUCT NUMBER	SIZE	CONNECTIONS *	FLOW RANGE	C,
7201	%⁵	½":Union Nut with Gasket x ½" FPT	0.5- 2.2 GPM	2.2
7202	1/2"	%" Union Nut with Gasket x %" FPT	1.0- 4.0 GPM	2.2
7205	3//"	%" Union Nut with Gasket x %" Union Nut with Gasket	1.5- 5.0 GPM	5:4
7206	3/4"	%" Union Nut with Gasket x %" Union Nut with Gasket	2.0- 8.0 GPM	5.6

The Flo-Setter can be installed in any position, and has a directional arrow located on the body of the valve. System requirements can be fine tuned by adjusting the Flo-Setter's ball valve.

TAILPIECE AND ADAPTER

PRODUCT NUMBER	SIZE	CONNECTIONS.
7201-003	1/2"	½" NPT Tailpiece for Union End
7201-004	1/2"	1/2" Sweat Tailpiece for Union End
7201-005	1/2"	1/2" Sweat x 1/2" NPT Adapter for Threaded End
7205-009	3/4"	3/4" NPT Tallpiece for Union Ends
7205-010	3/4"	¾" Sweat Tailpiece for Union Ends





 C_{ν} is the flow in GPM with a pressure loss of one PSI through the Flo-Setter. C_{ν} is shown with valve fully open.

$$C_{V} = \frac{GPM}{\sqrt{\Delta PSI}} \qquad \Delta PSI = \left(\frac{GPM}{C_{V}}\right)$$

$$4\frac{1}{4}m$$

$$(114mm)$$

$$\frac{4}{2}m$$
Flo-Setter

1/2" Sweat x 1/2" Sweat

SPECIFICATIONS

Pressure

125psi Maximum

Temperature

180°F Maximum

Accuracy

+10% of Full Scale

* NOTE: The type of tallpiece, male NPT or Sweat Connection must be selected and ordered to make a complete Fio-Setter.

MATERIALS

Body

Brass, Nickle Plated

Sight Glass

Polysulfone

Seals

EPDM

COMPARE. YOU'LL TAKE TACO.

TACO, INC., 1160 Cranston Street, Cranston, Rl 02920 (401) 942-8000 FAX: (401) 942-2360.

Printed in USA



INSTRUCTION SHEET

NUMBER

IS100-4.5

Effective: February 1, 1983

Supersedes: IS100-4.5

dated 4/1/82

FLO-SETTER

IN-LINE FLOW METER and BALANCING VALVE 7201, 7202 7205, 7206

Plant ID No. 001-904

INSTALLATION:

The Taco Flo-Setter can be placed at any location in the system. The preferred location is in a return

pipe. It works reliably in any position.

FLOW SETTING:

Turn the stem of the ball valve by using a screwdriver in the stem slot until the desired flow is ob-

served at the end of the float indicator.

Stem slot in flow direction: valve is full open.

Stem slot across flow: valve is closed.

NOTE: In case of poor light or murky water, a flashlight and mirror directing the light through

the sight glass is recommended.

APPLICATION DATA:

Pressure rating - 125 psi max.

Temperature rating - 210°F max. (continuous)

The Flo-Setter can withstand exposure to water as hot as 300°F for a few minutes as might occur

in a static situation in a solar system. Accuracy — ± 10% of full scale.

Acceptable Fluids

Water, mixtures of water and ethylene glycol or propylene glycol, solar fluids not containing hy-

drocarbons.

·Taco, Inc. 1160 Cranston Street, Cranston, Rhode Island 02920 Telephone: (401) 942-8000 Telex: 92-7627



HAYWARD INDUSTRIAL PRODUCTS, INC.

900 FAIRMOUNT AVENUE . P.O. BOX 18 . ELIZABETH, NEW JERSEY 07207

908-351-5400 FAX 908-351-7706

BUTTERFLY VALVE

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

INSTALLATION

Hayward Butterfly Valves should be installed between two pipe flanges. In dead end service, it is recommended they be installed between one pipe flange and a downstream companion or blind flange.

The "Lug" design can be installed on one pipe flange with a maximum upstream pressure of 75 PSI; flow must be in the direction of the arrow on the body. The use of additional gaskets are not necessary and not recommended.

When installed between two existing flanges, the flanges should be separated to provide clearance on the face to face of valve. This will prevent the valve sealing surfaces from distortion during installation. Pipe flange faces should be clean, free of debris, and old gasket material. Additionally, the flange sealing surfaces of the liner should be lightly lubricated using a non-hydrocarbon base lubricant such as "Non-Fluid Oil" #666.

Hayward Butterfly Valves are designed for use with all pipe flanges up to and including schedule 80. Should the use of pipe flanges greater than schedule 80 (example: schedule 120) occur, the inside of the flange at the valve must be chamfered to a diameter greater than or equal to the inside diameter of schedule 80 pipe. Sharp edges and burrs must be removed.

The Butterfly Valve should be open to approximately 15° when installed. Do not open fully during installation to prevent possible damage to the edge of the disc by the mating flanges.

With actuated valves, follow these procedures for opening of disc to approximately 15°.

ELECTRIC:

Apply power to actuator for a short duration to allow disc to partially open (approx. 15°).

PNEUMATIC:

Double Acting: (Air to Air) with air lines disconnected use manual override to rotate disc to partially open

position (approx. 15°).

Spring Return: (Air to Spring) with the air supply connected, and an air regulator installed in the air supply line; slowly adjust the air regulator upward from "O" PSI until just enough air pressure has been applied to the actuator, to partially open the disc (approx. 15°).

Install the valves using well-lubricated studs or bolts with metal back-up washers on both pipe flanges. With a torque wrench, uniformly tighten nut (or bolt) to approximately 15 foot pounds in an alternating sequence, diametrically opposed to the previously tightened nut. Final tightening should be performed in the same sequence following the recommended torque in the following chart.

The maximum allowable displacement is 1/8" off pipe center in any direction. Maximum angular misalignment of 3/32" for 3" and 4" valves, and 1/8" for 6" and 8" valves is allowed.

Normal pipe hanger spacing is recommended. Do not allow valve to support the weight of pipe. When using pneumatic or electric actuators, additional support directly to the actuator is recommended.

RECOMMENDED FLANGE BOLT TORQUE FOR PLASTIC BUTTERFLY VALVES

				Torque Ft. x Lb.
Size (In.)	Stud Dia. (In.)	Bolt Dia.	Flat Face	Van-Stone
		(In.) Thread	Type Flange	Type Flange
3	5/8	5/8 - 11UNC	20-25	10-20
4	5/8	5/8 - 11UNC	20-25	10-20
6	3/4	3/4 - 10UNC	30-40	10-20
8	3/4	3/4 - 10UNC	30-40	20-30

NOTE: On Butterfly Valves of the "Lug" design, bolts are recommended.

OPERATION

When installation is complete, check for proper alignment. Fully open and close the valve by rotating through 360° for 6 revolutions. For actuated valves, fully open and close the valve 6 times.

Flange bolt torques in excess of those recommended will increase valve operating torque.

Maximum operating pressure at ambient temperature when installed between two flanges is 150 PSIG.

MAINTENANCE & DISASSEMBLY OF VALVE

- I. Minimal valve maintenance is required: the valve is field repairable.
- II. Actuator Assembly: actuators can be removed without removing valve from line. The line should be depressurized before any actuator is removed.
 - A. Handle Assembly: remove black logo bezel by lifting with thin screwdriver or knife, exposing slotted head screw. Remove screw and flat washer. Lift off handle.
 - B. Gear Actuator: remove four (4) hex nuts which hold actuator to body.
 - C. Pneumatic/Electric Actuator: is removed by unscrewing four (4) socket head cap screws and hex nuts which hold the bracket to the body.

III. VALVE DISASSEMBLY

- 1. Remove cap plug from bottom of valve body (use a ½" drive rachet). Remove o-ring.
- 2. Remove shaft by pushing from top, out through bottom of valve body.
- 3. Remove upper elastomeric moisture seal.
- 4. Remove upper bearing (use the shaft to twist out).
- 5. Remove lower bearing (use the shaft to twist out.)
- 6. To remove seal retainers, place shaft through one seal retainer and approximately ¾ through the disc. Rotate disc approximately 30°, push shaft through disc against opposite seal retainer. Corners of shaft will push against flats of seal retainer. Remove shaft, and insert from opposite side of disc. Rotate disc approx. 30° and push out remaining seal retainer.
- 7. Slide disc out of liner.
- 8. Remove liner by peeling interlock section from body and folding liner into a heart shape. If the valve is of the "Lug" design, the liner is not removable.
- 9. Inspect all parts for wear and replace as necessary.
- 10. To reassemble: lightly lubricate all moving parts and seals (using lubricants suggested on Page 1) and reverse above procedure.

IV. "LUG" MOUNTING

Valves equipped for lug mounting have specially designed stainless steel threaded inserts affixed to the body to allow installation without the use of a downstream flange. Valves used in this type of application have been derated for pressure applications, to a maximum of 75 PSI. The valves can also be used with downstream flanges, in which case, full-rated pressure of 150 PSI is applicable. The advantage to the Lug design is that it allows installation of the valve to be such, that to change flange connections of either side of the valve, the valve does not have to be removed from the piping system.

BYIS

8/29/90 REV. B

SECTION 6

MONTHLY MAINTENANCE AND TROUBLESHOOTING

TROUBLESHOOTING GUIDE

NEPCCO strives to manufacture low maintenance, trouble free remediation systems, however an occasional problem may arise. The following guideline has been developed to aid the technician in troubleshooting the system in the field.

Should you require further assistance, please call NEPCCO's Field Service number @ 1-800-277-3279. In order to provide fast efficient technical assistance, PLEASE REFER TO NEPCCO'S 6 DIGIT EASYPURGETM SYSTEM NUMBER IN ALL CORRESPONDENCE. This number is easily located on the system manual cover, on all engineering drawings, inside all control panels and is permanently stamped on the skid deck near the control panel stanchion. Not providing the system number may cause a delay in obtaining technical assistance.

CAUTION

SOME TROUBLESHOOTING PROCEDURES MAY INVOLVE MEASURING AC VOLTAGES. AC VOLTAGE MEASUREMENTS, ELECTRICAL MAINTENANCE AND REPAIRS SHOULD BE PERFORMED BY QUALIFIED SERVICE PERSONNEL

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SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
RECOVERY WELL PUMP WILL NOT OPERATE	Probe placed incorrectly in well	Verify that the probe is placed at the correct depth in the well
	Bad pump motor	If pump does not operate in the manual position and the control panel delivers 240 VAC to the pump motor, replace the pump motor
	Internal or external thermal overloads	Reset thermal overload. Check the recovery well pump for proper depth Check pump inlet for any debris blockage Ensure that the pump shaft rotates freely Ensure that excessive cycling does not occur
	Bad probe	Perform continuity test as per the HydroPurge™ or PetroPurge™ section of the manual
	Bad logic card	If the pump runs when the control panel switch is in the manual position and not in the "AUTO" position, and all of the above checks have been performed to verify that the probe is good, swap or replace the logic card. Ensure the logic card is plugged in correctly.
1	Control panel switches in "OFF" position	Place switches to the "AUTO" position
	Circuit breaker tripped or in "OFF" position	Reset breaker or place in the "ON" position
	Incorrect wiring	Verify that pump motor is wired correctly as per system manual
	Control panel power supply	Verify that the 5VDC power supply is operational "RED LED ON"



POSSIBLE CAUSES	CORRECTIVE ACTION
Main service disconnect tripped	Reset breaker
System circuit breaker tripped or in the "OFF" position	Reset breaker
Motor running backwards	Verify that blower motor is wired correctly
Blower blade binding Damper not adjusted correctly	With all power off determine cause of binding Loosen set screw and adjust damper as necessary
Debris blocking inlet screen	Remove any debris that may have collected at inlet screen
Starter switch in "OFF" position	Place switch to "ON" or "START"
Blower circuit breaker tripped or in "OFF" position if so equipped	Reset breaker or place to "ON" position
Blower motor starter thermal overload tripped	Reset thermal overload
System failsafe, if so equipped	Corrective action for recovery well pump also applies to transfer pumps with the exception that transfer pumps
Bad multi-level probe	operate with a multi-level probe. Please refer to the Pump & Controller section of the system manual for multi-level probe test procedures.
	Main service disconnect tripped System circuit breaker tripped or in the "OFF" position Motor running backwards Blower blade binding Damper not adjusted correctly Debris blocking inlet screen Starter switch in "OFF" position Blower circuit breaker tripped or in "OFF" position if so equipped Blower motor starter thermal overload tripped System failsafe, if so equipped



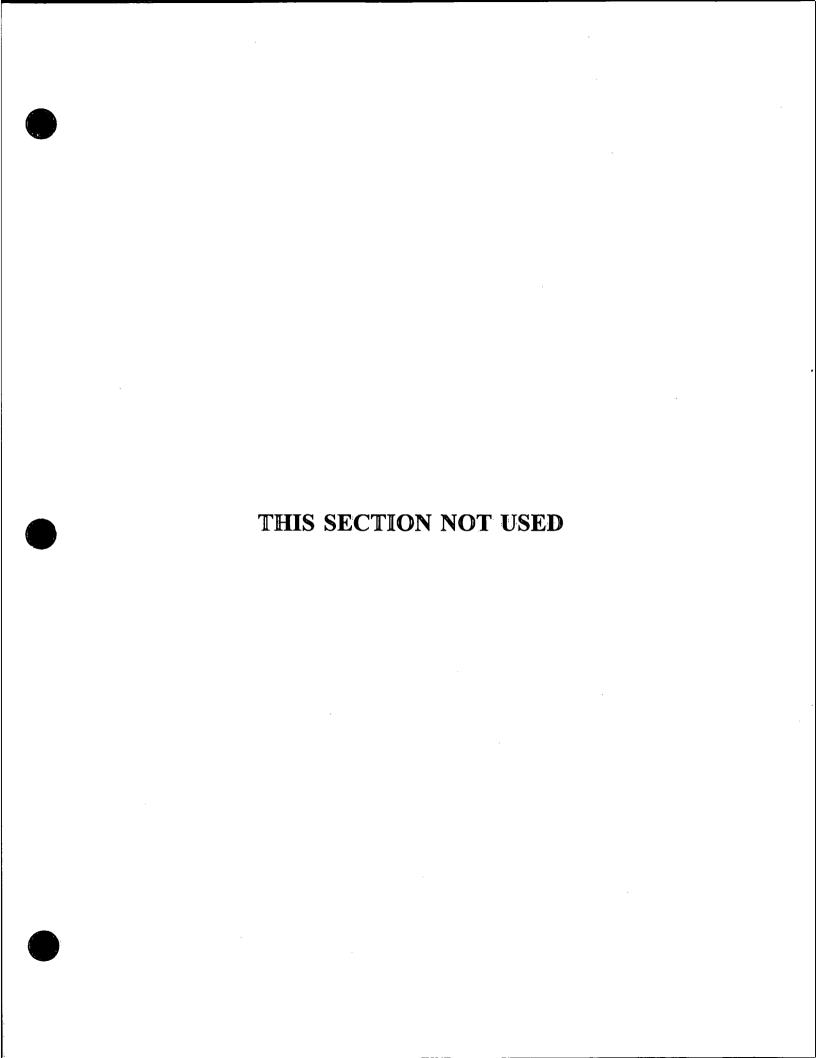
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
RECOVERY WELL PUMP CYCLES INCORRECTLY	Probe connected incorrectly	Refer to manual and verify probe connections
	Probe placed incorrectly	Refer to manual and verify correct probe placement
	Logic card inoperative	Replace logic card
		The above procedure applies to transfer pumps with the
TRANSFER PUMP CYCLES INCORRECTLY	Multi-level probe operating incorrectly	exception that transfer pumps operate with a multi-level probe
CONTROL PANEL	No AC power	Verify AC power at TB-1
	Power supply inoperative	Verify that 5VDC power supply is operational, "RED LED ON". Check fuses and replace as necessary
FAILSAFE PANEL WILL NOT RESET	Failsafe condition not corrected	All failsafe sensors are wired normally open and the failed condition is closed. Verify that the failsafe condition has been corrected
BLOWER FAILSAFE WILL NOT RESET	Air line to pressure switch blocked	Clear lines or tubing of water or debris from sump to pressure switch.
	Blower not running	Verify that the blower is running
· · ·	Blower damper closed	Open and adjust blower damper
LEVEL SENSORS WILL NOT WORK	Level sensor floats inoperative	Ensure that the floats operate freely Ensure that all Hi-Hi level sensors are in the DOWN N. O. position and all Lo-Lo sensors are in the UP N.O. position



SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
AIR COMPRESSOR INOPERATIVE	No AC power	Verify AC power at motor starter Verify AC power at motor weather head
	Low oil level	Check oil level and fill
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SECTION 7

NOTES



APPENDIX C-2
Roots Blowers





INSTRUCTIONS ROTARY LOBE BLOWERS

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INSTALLATION	ServicingRepairsClearances	10
LUBRICATION7	PARTS DRAWINGS	14
Oil FillServicingGreasing	DISTRIBUTORS	24

DO THESE THINGS To Get The Most From Your Roots Blower

- Check shipment for damage. If found, file claim with carrier and notify Sales Office.
- Unpack shipment carefully, and check contents against Packing List. Notify Sales Office if a shortage appears.
- Store in a clean, dry location until ready for installation, if possible. Lift by methods discussed under IN-STALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.
- Read LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation.
- 5 Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. See SAFETY PRECAUTIONS.
- 5 Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.

- Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.
- Read starting check points under OPERATION. Run equipment briefly to check for installation errors and make corrections. Follow with a trial run under normal operating conditions.
- In event of trouble during installation or operation, do not attempt repairs of Roots furnished equipment. Notify Sales Office or factory, giving all nameplate information plus an outline of operating conditions and a description of the trouble.
- Unauthorized attempts at equipment repair may void Manufacturer's warranty. Units out of warranty may be repaired or adjusted by the owner. It is recommended that such work be limited to the operation described in this manual, using Factory Parts. Good inspection and maintenance practices should reduce the need for repairs. See Distributor List on last page for parts and service after warranty period.

NOTE — Information in this manual is correct as of the date of publication. The Manufacturer reserves the right to make design or material changes without notice, and without obligation to make similar changes on equipment of prior manufacture.

OPERATING CHARACTERISTICS

Roots UNIVERSAL RAI® blowers, as covered in this manual, are designated as air blowers, and may be used for handling air in either pressure or vacuum service. They are unsuitable for handling gases because shaft seals are not designed to prevent leakage to atmosphere.

The Roots rotary lobe blower is a positive displacement type unit, whose pumping capacity is determined by size, operating speed and pressure conditions. It employes two double-lobe impellers mounted on parallel shafts and rotating in opposite directions within a cylinder closed at the ends by headplates. As the impellers rotate, air is drawn into one side of the cylinder and forced out the opposite side against the existing pressures. The differential pressure developed, therefore, depends on the resistance of the connected systems.

Effective sealing of the blower inlet area from the discharge area is accomplished by use of very small operating clearances. Resulting absence of moving contacts eliminates the need for any internal lubrication. Clearances between the impellers during rotation are maintained by a pair of accurately machined timing gears, mounted on the two shafts extending outside the air chamber.

Operation of the familiar basic rotary lobe blower is illustrated in FIGURE 1, where air flow is right to left from inlet to discharge with the bottom impeller rotating clockwise. In Position 1 it is delivering a known volume (A) to the discharge, while space (B) between the upper impeller and cylinder wall is being filled. Counterclockwise rotation of this impeller then traps equal volume (B) in Position 2, and further rotation delivers it to the discharge in Position 3. At the same time, another similar volume is forming under the lower impeller, and will be discharged when rotation reaches Position 1 again.

One complete revolution of the driving shaft alternately traps four equal and known volumes of air (two by each impeller) and pushes them through to the discharge. The pumping capacity of a lobe blower operating at a constant speed therefore remains relatively independent of reasonable inlet or discharge pressure variations. To change capacity, it is necessary either to change speed of rotation or vent some of the air.

No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This increases the power load on the driver, and may seriously damage the blower. Likewise, if a possibility exists that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve must be installed near the blower. A pressure type relief valve in the discharge line near the blower is also strongly recommended for protection against cut-off or blocking in this line.

When a belt drive is employed, blower speed can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves. See pages 18 and 20 for minimum sheave diameter. In a direct coupled arrangement, a variable speed motor or transmission is required, or air may be vented through a manually controlled unloading valve and silencer. If discharge air is returned to the blower inlet, it must be cooled to 100° F (38° C) through a cooling by-pass arrangement.

Before making any change in blower capacity or operating conditions, contact the nearest Distributor for specific information applying to your particular blower. In all cases, operating conditions must be maintained within the approved range of pressures, temperatures and speeds as stated under LIMITATIONS. Also, the blower must not be used to handle air containing liquids or solids, or serious damage to the rotating parts will result.

OPERATING LIMITATIONS

To permit continued satisfactory performance, a Roots UNIVERSAL RAI® blower must be operated within certain approved limiting conditions. The Manufacturer's warranty is, of course, also contingent on such operation.

Maximum limits for pressure, temperature and speed are specified in Table 1 for various sizes of UNIVERSAL RAI® blowers. These limits apply to all blowers of normal construction, having operating clearances as listed in Table 5 when operated under standard atmospheric conditions. Do not exceed any of these limits.

Example: The listed maximum allowable temperature rise (increase in air temperature between inlet and discharge) for any particular blower may occur well before its maximum pressure or vacuum rating is reached. This can easily occur at high altitude or at very low speed.

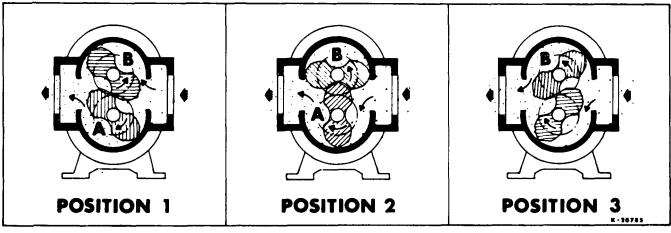


Figure 1 — Flow Through a Basic Type RAI Blower

Temperature rise then is the limiting condition. In other words, the operating limit is always determined by the maximum rating reached first. It can be any one of the three: pressure, temperature or speed.

Be sure to arrange connections or taps for thermometers and mercury type pressure or vacuum gauges at or near the inlet and discharge connections of the blowers. These, along with a good tachometer, will enable periodic checks of operating conditions to be made easily.

PRESSURE — On pressure service, the pressure rise in pounds per square inch (kPa) (between blower inlet and discharge) must not exceed the figure listed for the specific blower frame size concerned. Also, in any system where the blower inlet is at a positive pressure above atmosphere, the discharge pressure must never exceed 25 PSI (172 kPa) gauge regardless of blower size.

On vacuum service, with the discharge going to atmospheric pressure, the inlet suction or vacuum in inches of mercury (Hg.) (kPa) must not be greater than the values listed for the specific frame size.

TEMPERATURE — Various blower frame sizes are approved only for installations where the following temperature limitations can be maintained in service.

- A. Measured temperature rise in Fahrenheit degrees (C°) must not exceed listed values when the inlet is at ambient temperature. Ambient is considered as the general temperature of the space around the blower. This is not outdoor temperature unless the blower is installed outdoors.
- B. If inlet temperature is higher than ambient, the listed allowable temperature rise values must be reduced by ²/₃ of the difference between the actual measured inlet temperature and the ambient temperature.
- C. Average of inlet plus discharge temperature must not exceed 250°F (139°C).

SPEED RANGE — UNIVERSAL RAI® blowers may be operated at speeds up to the maximums listed for various frame sizes. They may be direct coupled to suitable constant speed drivers if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be the limiting factor as noted in the preceding example.

Table 1 — Maximum Allowable Operating Conditions

Frame Size	Speed RPM	Inlet Vac. Inches Hg. (kPa)	Temp. Rise Fahr. Deg. (C°)	Press. Rise PSI (kPa)
22	5275	14 (47)	225 (125)	12 (82)
24	5275	14 (47)	185 (102)	7 (47)
32	3600	14 (47)	225 (125)	15 (101)
33	3600	14 (47)	170 (94)	12 (82)
36	3600	14 (47)	145 (81)	7 (47)
42	3600	14 (47)	240 (133)	15 (101)
45	3600	14 (47)	170 (94)	10 (68)
47	3600	14 (40)	140 (78)	7 (47)
53	2850	14 (47)	195 (108)	15 (101)
56	2850	14 (47)	180 (100)	10 (68)
59	2850	14 (40)	145 (81)	7 (47)
65	2350	16 (53)	250 (139)	15 (101)
68	2350	16 (53)	240 (133)	12 (82)
615	2350	12 (40)	130 (72)	6 (40)
76	2050	16 (53)	250 (139)	15 (101)
711	2050	16 (53)	210 (117)	10 (68)
718	2050	12 (14)	130 (72)	6 (40)

BLOWER ORIENTATION

The unique removable feet feature of Roots UNIVER-SAL RAI® blowers permit field modification of blower mounting by repositioning blower feet and gear box breather as shown in Fig. 3.

Four blower mounting positions are possible:

- Horizontal mounting, vertical air flow, drive shaft on left.
- 2. Same as (1) except drive shaft on right.
- Vertical mounting, horizontal air flow, drive shaft on bottom.
- 4. Same as (3) except drive shaft on top.

To change blower mounting:

- 1. Place blower on its feet.
- 2. Loosen feet capscrews (32).
- Place blower on a solid base resting on the gear box end with drive shaft on top.
- Remove feet. (Note Feet capscrews (32) are longer than cylinder capscrews (26), only capscrews (32) are to be used for feet.)
- Remove cylinder capscrews (32) where feet are to be re-installed. Install capscrews (26) in the location previously occupied by feet capscrews (32).
- 6. Install feet using capscrews (32).
- 7. Place blower on its feet on flat surface.
- Loosen feet capscrews (32) and square up blower and re-tighten capscrews (32).
- 9. Gear box has four threaded holes, one with breather and three with pipe plugs. Remove pipe plug (21) from the top most hole. Remove breather (25) and install it in the top most hole. Install pipe plug that was removed from the top hole into the hole previously occupied by the breather. The breather and the pipe plug should be sealed with a thread sealer.

For convenience, the position of the grease fitting (37) and the relief fitting (38) could be interchanged, however each bearing must have one grease fitting (37) and one relief fitting (38).

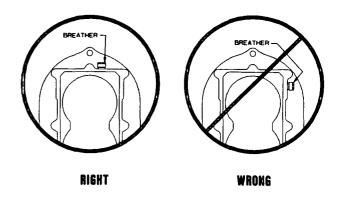


Figure 2 — Breather Installation

Figure 3 — Blower Orientation and Lubrication Points

INSTALLATION

Roots UNIVERSAL RAI® blowers are internally and externally treated after factory assembly to protect against normal atmospheric corrosion before installation. Maximum period of internal protection is considered to be one year under average conditions, if closing plugs or seals are not removed. Protection against chemical or salt water atmosphere is not provided. Avoid opening the blower until ready to start installation, as protection will be lost quickly by evaporation.

NOTE — If there is to be an extended period between delivery (and/or installation) and startup, the following steps should be taken to insure corrosion protection:

- Coat internals of cylinder and gearbox with Nox-Rust No. VCI10 or equivalent. Repeat once a year or as conditions may require. Motorstor is oil soluble and does not have to be removed before lubricating. If desired, No. VCI10 may be removed from within the cylinder shortly before startup by spraying a fine mist of petroleum solvent through the blower while it is running at a slow speed with open inlet and discharge, or it can remain in the blower if it is not harmful to the operation of the connected system.
- Fill drive end bearing cavities with grease as specified in Lubrication section.
- Paint shaft extension, inlet and discharge flanges, and all other exposed surfaces with Nox-Rust X-110 or equivalent.
- 4. Seal inlet, discharge, and all vent openings with tape. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Motorstor vapor will escape and lose its effectiveness.
- Units are not to be subjected to excessive vibration during storage. If stored outdoors, provide coverage such as a tarpaulin or lean-to.
- Rotate drive shaft three or four revolutions every two weeks.
- Prior to startup, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust. Check all internal clearances. Also, at this time, remove gearbox and inspect gear teeth for rust.

Because of the completely enclosed blower design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is to be preferred. However, an outdoor or wet location will normally give satisfactory service. Important requirements are that the correct grade of lubricating oil be provided for expected temperatures, and that the blower be located so that routine checking and servicing can be handled conveniently after installation. Effect of the location on driver and accessory equipment must also be considered.

Supervision of the installation by a Factory Service Engineer is not usually required for these blowers. Workmen with experience in installing light-medium weight machinery should be able to produce satisfactory results. Handling of the equipment needs to be accomplished with care, and in compliance with safe practices. Blower mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

A bare blower without base should be lifted by a rope sling, with one loop passing under the gearhouse and the other loop under the cylinder.

When a blower is furnished mounted on a baseplate, with or without a driver, use of lifting slings passing under the base flanges is required. Arrange these slings so that no strains are placed on the blower casing or mounting feet, or on any mounted accessory equipment.

Before starting the installation, remove plugs, covers or seals from blower inlet and discharge connections and inspect the interior completely for dirt or foreign material. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with a petroleum solvent such as DuPont Triclene D. After this, turn the drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the drive shaft extension may also be removed at this time with the same solvent. Then plug the inlet and discharge connections to keep out dirt until ready to connect the air piping. Washing out is not required if the interior is found to be clean. The corrosion inhibitor used will vaporize and disappear during operation.

Care, plus consideration of all possible problems, will pay dividends when arranging the blower mounting. This is especially true when the blower is a "bare" unit furnished without a baseplate. The convenient procedure may be to mount such a unit directly on a floor or small concrete pad, but this generally produces least satisfactory results. It definitely causes the most problems in leveling and alignment.

Direct use of structural framing members is also not a recommended mounting. If unavoidable, the members must be rigidly reinforced when part of a building, and spring type mountings should not be used. Noise transmission can usually be reduced by use of a cork insulating pad 1 to 2 inches (25 to 50 mm) thickness. The pad should be supported by a full steel plate attached to the structure, with a rigid concrete slab laid on top of the cork to carry the blower and driver.

For a blower without base, it is recommended that a well anchored and carefully leveled steel or cast iron mounting plate be provided at the installation point. The plate should be ¾ to 1¼ inches (19 to 32 mm) thick, with its top surface machined flat, and needs to be large enough to provide leveling areas at one side and one end after the blower is mounted. It should have properly sized studs or tapped holes located to match the blower foot drilling. As an alternative, smaller plates at each end of the blower may be used. This is more complicated, usually makes leveling more difficult, and can produce twist or strains in the blower. Use of a high quality machinist's level is important. With the mounting plate in place and leveled, set the blower on it without bolting and check for rocking. If it is not solid, determine the total thickness of shims required under one foot to stop the rocking. Place half of this under each of the two short feet, and tighten the mounting studs or screws. Rotate the drive shaft to make sure the impellers still turn freely. If the blower is to

be direct coupled to a driving motor, consider the height of the motor shaft and the necessity for it to be aligned very accurately with the blower shaft. Best arrangement is for the blower to be bolted directly to the mounting plate while the driver is on shims of at least ½ inch (3 mm) thickness. This allows adjustment of motor position in final shaft alignment by varying the shim thickness.

Satisfactory installation can be obtained by setting the baseplate on a concrete slab that is rigid and free of vibration, and leveling the top of the base carefully in two directions so that it is free of twist. The slab must be provided with suitable anchor bolts. The use of grouting under and inside the base, after it has been carefully leveled by shimming, is recommended.

When blower and driver have been factory mounted on a common baseplate, the assembly will have been properly aligned and is to be treated as a unit for leveling purposes. It is possible for a base mounted assembly to become twisted during shipment thus disturbing the original alignment. For this reason, make the following checks after the base has been leveled and bolted down. Disconnect the drive and rotate the blower shaft by hand. It should turn freely at all points. Loosen the blower foot hold-down screws and determine whether all feet are evenly in contact with the base. If not, insert shims as required and again check for free impeller rotation. Finally, if blower is direct coupled to the driver, check shaft and coupling alignment carefully and make any necessary corrections prior to grouting.

In planning the installation, and before setting the blower, consider how piping arrangements are dictated by the blower design and assembly.

When a blower is DIRECT COUPLED to its driver, the driver RPM must be selected or governed so as not to exceed the maximum speed rating of the blower. Refer to LIMITATIONS for allowable speeds for various blower sizes. A flexible type coupling should always be used to connect the driver and blower shafts.

For engine drives, couplings with proper stiffness must be selected to avoid resonant torisonal vibrations. Also, safe operating speed must be limited to avoid critical speeds.

Coupling halves must be accurately aligned, and a sufficient gap between shaft ends provided, so that side strains and end thrust on either shaft are avoided or minimized. This will require considerable care in the mounting of the driver. The two shafts must be in as near perfect alignment in all directions as possible, and the gap must be established with the motor armature on its electrical center if end play exists. Coupling halves must be fitted to the two shafts such that they can be worked into place by hand. Maximum deviation in offset alignment of the shafts should not exceed .005" (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum deviation from parallel of the inside coupling faces should not exceed .001" (.03 mm) when checked at six points around the coupling.

CAUTION

Couplings as well as sheave bushings must have a slight slide fit with the blower shaft such that they can be installed in place by hand. Any force used to install them will change blower end clearances resulting in blower damage. If an interference fit is desired for the coupling, the coupling hub should be heated and shrunk on the shaft. For engine drives, use "Locktite" between the coupling hubs and the blower/engine shafts and on the threads of the coupling set screws.

When a blower is BELT DRIVEN, a proper selection of sheave diameters can usually be made to adapt any standard driver speed to the required blower speed. This flexibility can sometimes lead to operating temperature problems caused by blower speed being too low. Make sure the drive speed selected is within the allowable range for the specific blower size, as specified under LIMITATIONS.

Belted drive arrangements usually employ two or more V-belts running in grooved sheaves, and a variety of positions are available for the driver. Installation of the driver is less critical than for direct coupling, but its shaft must be level and parallel with the blower shaft. The driver must also be mounted on an adjustable base to permit installing, adjusting and removing the V-belts. To position the driver correctly, both sheaves need to be mounted on their shafts and the nominal shaft center distance known for the belt lengths to be used.

Install the blower sheave (usually the larger one) so that its inner hub face is not more than ¼ inch (7 mm) from the bearing end cover. The shaft fit should be such that the sheave can be worked into place by hand. A tight or driving fit can damage a bearing, and may cause internal blower damage by forcing the impeller out of its normal operating position. A loose fit or wobbly sheave will cause vibration, and may result in shaft breakage.

The driver sheave should also be mounted as close to its bearing as possible, and again should fit the shaft correctly. Position the driver on its adjustable base so that ½ of the total movement is available in the direction away from the blower, and mount the assembly so that the face of the sheave is accurately in line with the blower sheave. This position minimizes belt wear, and allows sufficient adjustment for both installing and tightening the belts. After belts are installed, adjust their tension in accordance with the manufacturer's instructions. However, only enough tension should be applied to prevent slippage when the blower is operating under load. Excessive tightening can lead to early bearing failures.

Failure to properly align the blower and drive sheaves will result in the impeller being forced against one of the headplates during operation causing serious damage to the blower.

In the absence of belt manufacturer's instructions for tensioning, the following procedures may be used.

- With the belts loose, pull the slack on all of them to the bottom side of the drive.
- 2. Adjust motor position to tighten belt until they appear to be seating in the sheave grooves.
- Thump the belts with your fist. If they feel dead, tighten them more until they vibrate and feel springy when struck.
- 4. Run-in the drive for a short period, after preparing the blower as instructed in a following paragraph. While running, adjust until only a very slight bow appears in the slack side of the belts.
- Stop the motor and compare the tensions of the individual belts by pressing down firmly with one hand on the top surface. It should be possible to deflect each

belt only to the point where its top surface is even with the bottoms of the other undeflected belts.

6. A new set of belts should be first tensioned about ½ greater than normal to allow for stretch and wear-in. Before putting the drive into normal operation, increase the tension as obtained above by a small amount. Recheck after each 8 hour operating period during the first 50 hours, and adjust as necessary.

Before operating the drive under power to check initial belt tension, first remove covers from the blower connections. Make sure the interior is still clean, then rotate the shaft by hand. Place a screen over the inlet connection to prevent anything being sucked into the blower while it is operating, and avoid standing in line with the discharge opening. Put oil in the gearhouse per instructions under LUBRICATION.

Before connecting piping, remove any remaining antirust compound from blower connections. Piping must be clean and should be sized so that the air velocity will not exceed 75 feet per second (23 m per second). Pipe used should be no smaller than blower connections. In addition, make sure it is free of dirt, scale, cuttings, weld beads, or foreign materials of any kind.

To further guard against damage to the blower, especially when an inlet filter is not used, install a substantial screen of 16 mesh backed with hardware cloth at or near the inlet connections. Make provisions to clean this screen of collected debris after a few hours operation. It should be removed when its usefulness has ended, as the wire will eventually deteriorate and small pieces going into the blower may cause serious damage.

Pipe threads or flanges must meet the blower connections accurately and squarely. Do not attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the blower casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive shaft. For similar reasons, piping should be supported near the blower to eliminate dead weight strains. Also, installation of flexible connectors or expansion joints is recommended.

Figure 4 represents in diagram form a blower installation with all accessory items that might be required under various operating conditions. Inlet piping should be completely free of valves or restrictions. When a shut-off valve (not shown) cannot be avoided, make sure a full size vacuum relief is installed near the blower inlet. This will protect against blower overload caused by accidental closing.

Need for an inlet silencer will depend on blower speed and pressure, as well as sound-level requirements in the general surroundings. An inlet filter is normally recommended, especially in dusty or sandy locations, for blower protection. A discharge silencer is also normally suggested. Specific recommendations on silencing can be obtained from the nearest Distributor. Silencers should be mounted as close to blower as possible.

Discharge piping requires a pressure relief valve, and should include a manual unloading valve to permit starting the blower under no-load conditions. Reliable pressure/vacuum gauges and good thermometers at both inlet and discharge are recommended to allow making the important checks on blower operating conditions. If the demand is constant, but somewhat lower than the blower

output, excess may be blown off through the manual unloading valve.

In multiple blower installations when two or more units discharge into a common header, use of check valves is recommended. These should be of a direct acting or free swinging type, with one valve located in each blower

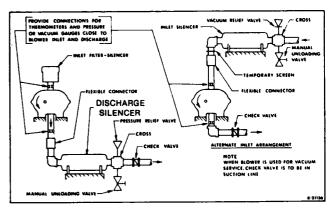


Figure 4 — Installation with Accessories

discharge line. Properly installed, they will protect against damage from reverse rotation caused by air backflow through an idle blower.

After piping is completed, and before applying power, rotate the drive shaft by hand again. If it does not move with uniform freedom, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment. Do not operate the blower more than briefly at this time because of possible inadequate oil supply in the gearhouse. Read LUBRICATION section.

LUBRICATION

A simple but very effective lubrication system is employed on UNIVERSAL RAI® blowers. At the drive shaft end the bearings are grease lubricated using hydraulic pressure relief fittings. These relief fittings vent any excess grease, preventing pressure build-up on the seals. A restriction plug and metering orifice prevent loss of lubricant from initial surges in lubricant pressure but permit venting excess lubricant under steadily rising pressures.

The blind end bearings and timing gears are enclosed by a gearhouse located opposite the drive end of the blower. In a side outlet blower, the lower timing gear functions as an oil slinger, carrying lubricant to the upper timing gear and providing splash lubrication for the bearings. Pressure within the gearbox is vented through the breather vent plug (25).

The above description also applies in general to the top or bottom outlet style blower, the principal difference being that both gears dip into the oil sump.

Before starting blower, be sure oil has been put in gearhouse, as ALL OIL WAS DRAINED FOLLOWING SHOP TESTS. For recommended lubricating oil see Table 2. Use a good grade industrial type rust, oxidation, and foam inhibited, non-detergent oil such as Mobil DTE BB, Texaco R&O 220, Amoco 220 or equal.

Table 2 — Recommended Oil Grades

Ambient Temperature ° F.	Viscosity Range SSU at 100° F.	Approx. ISO No.
(°C)	(38°C)	
Above 90° (32°)	1000 - 1200	320
32° to 90° (0° to 32°)	700 - 1000	220
0° to 32° (-18° to 0°)	500 - 700	150
Below 0° (– 18°)	300 - 500	100

To fill the gearbox, remove the breather plug and the oil overflow plug (Fig. 3). Fill the reservoir up to the overflow hole. Place the breather and the overflow plug back into their respective holes.

Table 3 — Oil Sump Capacities

Frame	Capacity, Fl. Oz. (Liters)		
Size	Vertical	Horizontal	
22	3.4 (.1)	6.1 (.18)	
24	3.4 (.1)	6.1 (.18)	
32	8.5 (.25)	16.0 (.47)	
33	8.5 (.25)	16.0 (.47)	
36	8.5 (.25)	16.0 (.47)	
42	12.7 (.37)	22.8 (.67)	
45	12.7 (.37)	22.8 (.67)	
47	12.7 (.37)	22.8 (.67)	
53	16.0 (.47)	27.6 (.82)	
56	16.0 (.47)	27.6 (.82)	
59	16.0 (.47)	27.6 (.82)	
65	28.3 (.84)	52.1 (1.54)	
68	28.3 (.84)	52.1 (1.54)	
615	28.3 (.84)	52.1 (1.54)	
76	32.3 (.96)	59.5 (1.76)	
711	32.3 (.96)	59.5 (1.76)	
718	32.3 (.96)	59.5 (1.76)	

Proper lubrication is usually the most important single consideration in obtaining maximum service life and the most satisfactory operation from the unit. Unless operating conditions are quite severe, a weekly check of gearhouse oil level and necessary addition of lubricant should be sufficient. However, oil should be changed after initial 100 hours of operation. Thereafter, a complete oil change normally is made after 1000 operating hours, or less, depending on the type of oil and oil operating temperature.

Shaft bearings at the drive end of the blower are grease lubricated and each bearing housing is equipped with pressure type grease fittings and pressure type relief fittings. When servicing drive end bearings, use a NLGI #2 premium grade, petroleum base grease with high temperature (300° service temperature) and moisture resistance and good mechanical stability. Using a pressure gun, force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fitting.

After a long shutdown, it is recommended that the grease relief fittings be removed, the old grease flushed out with kerosene or #10 lubricating oil, drained thoroughly, and bearings refilled with new grease. Be sure grease relief fittings are reinstalled. Grease should be added using hand operated grease gun to the drive end bearings at varying time intervals depending on duty cycle and RPM. Table 4 has been prepared as a general greasing schedule guide based on average operating conditions. More frequent intervals may be necessary depending on the grease operating temperature and under unusual circumstances.

Table 4 — Suggested Bearing Lubrication Intervals

Speed	Operating Hours Per Day			
in	8	16	24	
RPM	Greasing Intervals in Weeks			
750 - 1000	7	4	2	
1000 - 1500	5	2	1	
1500 - 2000	4	2	1	
2000 - 2500	3	1	1	
2500 - 3000	2	1	1	
3000 and up	1	1	1	

OPERATION

Before operating a blower under power for the first time, check the unit and the installation thoroughly to reduce the likelihood of avoidable troubles. Use the following procedure list as a guide, but consider any other special conditions in the installation.

- Be certain that no bolts, tools, rags or dirt have been left in the blower air chamber.
- 2. Be certain that inlet piping is free of debris. If an outdoor intake without filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the temporary protective screen at the blower as described under INSTALLATION is strongly recommended.
- 3. Recheck blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.
- 4. Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
- 5. Make sure oil level in blower gearbox is correct.
- Check lubrication of driver. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
- 7. Open the manual unloading valve in the discharge air line. If a valve is in the inlet piping, be sure it is open.
- 8. Bump blower a few revolutions with driver to check that direction of rotation is correct, and that both units coast freely to a stop.

After the preceding points are cleared, blower is ready for trial operation under "no-load" conditions as set up under Item 7. The following procedure is suggested to cover this initial operating test period.

- a. Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with power on and as speed slows down.
- b. Repeat above, but let blower run 2 or 3 minutes. Check for noises, and vibrations of 5 mils or greater.
- c. Operate blower for about 10 minutes unloaded. Check oil levels. Feel cylinder and headplate surfaces for development of spots too hot to touch, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have a final check run of at least one hour under normal operating conditions. After blower is restarted, gradually close the discharge unloading valve to apply working pressure. At this point it is recommended that a good pressure gauge or manometer be connected into the discharge line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower exceeds the limit specified in this manual shut down and investigate conditions in the piping system or in the process to which air is being supplied. Refer to the TROUBLE SHOOTING CHECKLIST for suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full speed. During the first few days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is supplying air to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet protective screen. If no appreciable amount of debris has collected, the screen may be removed. See comments under INSTALLATION. At this same time, verify leveling, coupling alignment or belt tension, and mounting bolt tightness.

Should operating experience prove that blower capacity is a little too high for the actual air requirements, a small excess may be blown off continuously through the manual unloading vent valve. Never rely on the pressure relief valve as an automatic vent. Such use may cause the discharge pressure to become excessive and can also

TROUBLE SHOOTING CHECKLIST

TROUBLE	ITEM	POSSIBLE CAUSE	REMEDY
No Air Flow	1	Speed too low	Check by tachometer and compare with speed shown on Roots Order Acknowledgement.
	2	Wrong rotation	Compare actual rotation with Figure 2. Change driver if wrong.
	3	Obstruction in piping	Check piping, screen, valves, silencer, to assure an open flow path.
Low capacity	4	Speed too low	See item 1. If belt drive, check for slippage and readjust tension.
	5	Excessive pressure	Check inlet vacuum and discharge pressure, and compare these figures with specified operating conditions on Order.
	6	Obstruction in piping	See item 3.
	7	Excessive slip	Check inside of casing for worn or eroded sur-
			faces causing excessive clearances.
Excessive Power	8	Speed too high	Check speed and compare with Roots Order Acknowledgement.
:	9	Pressure too high	See item 5.
	10	Impellers rubbing	Inspect outside of cylinder and headplates for
			high temperatures areas, then check for im-
			peller contacts at these points. Correct blower
			mounting, drive alignment.
Overheating of Bearings, or Gears	11	Inadequate lubrication	Restore correct oil levels in gearbox and lubricate.
	12	Excessive lubrication	Check gear oil level. If incorrect, drain and refill with clean oil of recommended grade.
	13	Excessive pressure rise	See item 5.
	14	Coupling misalignment	Check carefully. Realign if questionable.
	15	Excessive belt tension	Readjust for correct tension.
	16	Speed too low	Speeds lower than the minimum recommended will overheat the entire blower.
Vibration	17	Misalignment	See item 14.
•	18	Impellers rubbing	See item 10.
	19	Worn bearings/gears	Check gear backlash and condition of bearings.
	20	Unbalanced or rubbing impellers	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to retore original clearances and impeller balance.
	21	Driver or blower loose	Tighten mounting bolts securely.
	22	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping. Refer to Distributors.

result in failure of the valve itself. If blower capacity appears to be too low, refer to the TROUBLE SHOOTING CHECKLIST first. If no help is found there it may be possible to increase the blower speed. Before attempting this change, contact the nearest Distributor for recommendations. Be prepared to furnish data on actual air requirements and operating pressure/temperature conditions.

SAFETY PRECAUTIONS

For equipment covered specifically or indirectly in this instruction book, it is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should particularly be noted:

- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Cover external moving parts with adequate guards.
- Disconnect power before doing any work and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream.
- Stay clear of open inlet piping (suction area) of pressure blowers, and the open discharge blast from vacuum blowers.
- Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.
- Avoid extended exposure in close proximity to machinery which exceeds safe noise levels.
- Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.
- Casing pressure must not exceed 25 PSI (172 kPa) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents.
- Do not use air blowers on explosive or hazardous gases.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.

MAINTENANCE & REPLACEMENTS

A good program of inspection and maintenance servicing, followed consistently, is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are lubrication, checking for hot spots or increase in vibration and noise and the recording of operating pressures and temperatures. Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked frequently during the first month of full-time operation. Attention thereafter may be less frequent, depending on what the early checks have shown. Lubrication is normally the most important consideration. Unless operating conditions are unusually severe, a weekly check of oil levels in the gearbox, with addition of oil as required, should be sufficient. Complete oil changes should be made at intervals of 1000 operating hours, or more frequently if oil condition becomes poor.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent it from causing vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts. Refer to tensioning instructions under INSTALLATION.

In a new and properly installed blower there are no moving contacts between the two impellers, or between the impeller and cylinder or headplates. Wear is then confined to the bearing which support and locate the shafts, the shaft seals, and the timing gears. All are lubricated, and wear should be nominal if clean oil of the correct grade is always supplied. Seals are subject to deterioration as well as wear, and may require replacement at varying periods.

Shaft bearings have been selected to have optimum life under average conditions with proper lubrication. They are critical in the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and cylinder headplate. This will cause spot heating, which can be detected by feeling these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Shaft seals should be considered expendible items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal and is also affected by shaft smoothness under the seal lip. Because of these normal variables, minor seal leakage should not be considered an indicator for seal replacement.

Timing gear wear, when correct lubrication is maintained should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accom-

modate a normal amount of tooth wear without permitting contact between lobes of the two impellers.

However, a high oil level will cause churning and excessive heating, indicated by an unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance or backlash, and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Operating problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch (hundredths of a mm). This makes it possible for impeller interferences or casing rubs to result from shifts in the blower mounting or from changes in piping support. Foreign materials sucked into the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely before reconnecting it.

A wide range of causes for operating troubles are covered in the TROUBLE SHOOTING CHECKLIST. The remedies suggested there in some cases need to be performed by qualified mechanics with a good background of general experience, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to the nearest Distributor listed on the last page.

Warranty failures should not be repaired at all, unless specific approval has been obtained through a Distributor or a factory before starting work. Unauthorized disassembly within the warranty period may void the warranty.

When a blower is taken out of service it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgment based on existing conditions as well as length of downtime. Under favorable conditions, protection will probably not be needed if shut-down is not longer than a month. Under atmospheric conditions producing rapid corrosion, the blower should be protected immediately. If blower is to be shut down for an extended period of time, see suggestions for corrosion protection under installation.

It is recommended that major repairs, if needed, be performed at a Dresser authorized service facility. However, it is recognized that this may not always be practical, especially when a spare blower is not available. If a blower is out of the warranty period, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that Factory Parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give

Item Numbers and their word descriptions from Figures 5 & 6. Also specify quantities wanted and the blower size and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care and patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that a high percentage of bearing failure is caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following outlines of repair procedures, numbers shown in brackets () correspond to the Item Numbers used in assembly drawing, Figures 11 & 13. It is recommended that the procedure be studied carefully and completely, with frequent reference to the drawings, before starting work. This will produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

A — Replacing Timing Gears

- Drain all oil from the gearhouse by removing drain plug (21) in the bottom. Remove gearhouse by taking out all cap screws (23) in its flange. It may be necessary to bump the sides with a wood block or mallet to break the flange joint.
- Reach through one of the blower pipe connections and place a chalk mark on the strip of one impeller and the mating waist of the other, so that they may easily be returned to their original relative positions.

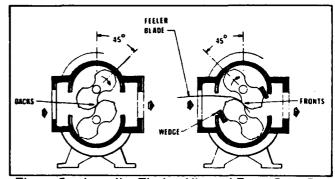


Figure 5 — Impeller Timing Viewed From Gear End

3. GEAR REMOVAL: For this operation, the impellers should be wedged as shown in Figure 5. Back off gear clamping nuts (17) about 1/4". Use a puller of the type shown in Figure 10. Position it around the gear per Figure 9. As the puller set screw is torqued, the puller will have a tendency to turn and contact teeth of the other gear. To prevent this contact, hold the puller corner nut with a wrench while torquing the set screw. Once the gear is unseated, remove the puller. Remove gear nuts (17) and the gear. Repeat same procedure for the other gear. NOTE: Do not remove gear nuts (17) completely before the gears are unseated from the taper fits or damage/injury may result.

4. GEAR INSTALLATION: Place impellers in correct position as previously marked. Be sure shafts and gear bores are clean and free of scratches. Clean the shaft tapered fits. Place hardwood wedges as shown in Figure 5. Install drive gear (4) and gear nut (17) so match mark at tooth is at the line of engagement. Tighten the drive gear nut to the torque given in Table 5. Blower assembly must be fastened down for torquing operation.

TABLE 5 — GEAR NUT TORQUE

Gear Size	Torque		
(in.)	lbft.	(kg-m)	
2.5	60	(8.3)	
3.5	110	(15.2)	
4.0	190	(26.3)	
5.0	250	(34.6)	
6.0	400	(55.3)	
7.0	550	(76.1)	

5. Installing driven gear (4) - Insert a long, metal feeler gauge between the impellers' lobes at the fronts or backs as shown in Figure 5. Feeler gauge thickness to be a middle value from Table 6 for fronts and backs. Align the gear so the tooth match marks agree with the drive gear, then install nut (17). Tighten lightly with a small wrench, then check front and back clearances against Table 6 for each 45° position. Both fronts and backs should be about the same and within the specified range in Table 6. Adjust gear position, if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear nut to the torque specified in Table 5. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts.

Caution! Keep fingers away from impellers and gears.

- 6. Check the end clearances between impellers and headplates. Adjust clearances per B-15 below.
- 7. When clearances are correct, clean and re-install the gearhouse. Check condition of flange gasket (7) and replace if questionable. Fill gearhouse to correct level with proper grade of oil.

B — Replacing Shaft Bearings, and Impellers

Remove coupling or sheave from the drive shaft. Drain and remove gearhouse, and pull the timing gears. If gears are to be re-used, mark them so they may be returned to the same shafts.

 Break corners and deburr the keyway. Remove bearing end cover at the drive end. Remove bearing clamp plates (34).

- Make single and double identifying punch marks on the mating edges of headplate and cylinder flanges at the two ends of the blower.
- 3. At the drive end, drive out the two dowel pins and remove all capscrews holding headplate to cylinder. By inserting jacking screws into the two threaded flange holes, and turning them in evenly, the headplate will be separated from the cylinder. As the headplate comes off the shafts it will bring bearings with it. 2½" and 3½" gear diameter units do not have tapped holes for jack screws in the drive end headplates. Remove dowel pins and all capscrews holding headplate to cylinder and foot on the drive end. Support unit under gear end cylinder flange with the shafts vertical. Using soft metal block against gear end shafts, push them out of gear end headplate.
- 4. For 2½" and 3½" gear diameter units, support the drive end headplate on the underside, and using soft metal block against drive end, shafts, push them out of drive end headplate.
 - For 4", 6" & 7" gear diameter units, from the gear end, using a wood or soft metal block against the ends of the shafts, drive them out of the headplate. If they are to be reused, protect them from damage in this operation.
- If blower interior surfaces need cleaning, it may be advisable to separate the gear end headplate from the cylinder. Use the same general procedure as employed at the drive end.
- 6. Working from the back (flat) face of each headplate, push or tap out the bearings and seals. Use a round bar or tube that will pass through the shaft clearance holes in the headplates. All lip seals will be damaged during removal and must be replaced.
- 7. Clean bearing and seal pockets in headplates and remove burrs or rough edges. (Apply a thin coating of sealant on seal O.D.) Press new seals (27) into gear end headplate using a round tube or bar with recessed end that will bear on the outer metal edge of seal enclosure. Seal lip should point toward the driving tool. Seals to be flush with outboard bore face. Apply a light coat of oil or grease to the seal lips. In a similar fashion, install lip seals into the drive end headplate.
- 8. Place cylinder on a flat surface. Assemble gear end headplate to cylinder after checking flange punch marks. Drive in the two locating dowel pins before tightening flange screws. Also install gear end foot using the same longer cap screws (32) and washers (41). (on 6" & 7" UNIVERSAL RAI® install both gear and feet.)
- 9. Place the assembly horizontally on steel blocks with gear end headplate on bottom. The height of the blocks should be sufficient to clear gear end shaft extensions. Assemble impellers into the cylinder with the drive shaft (longer shaft) in same

location as in original assembly. Before starting the shafts through the headplate holes, make sure shaft ends have no sharp or rough edges to damage seal lips. Position impellers at 90° to each other in the cylinder, using lobe-and-waist match marks if original impellers are being re-installed. Install drive end headplate and feet in same manner as gear end.

10. It is recommended that new bearings be used for rebuild. Apply thin film of machine oil on the shaft bearing fit, bearing I.D., and headplate bearing bore. Install drive end bearings into headplate. Use a tube with flanged end that will contact both bearing faces simultaneously. Refer to Fig. 11 for proper bearing depths.

NOTE: Cylindrical drive bearing should be installed with inner race large shoulder facing outboard.

- Place blower on its feet on a flat surface. Loosen feet capscrews (32) and square up unit. Re-tighten capscrews (32). Clamp unit down to a solid base for further assembly.
- 12. Oil the gear end bearing fits as described previously. Install 2½-5" UNIVERSAL RAI® gear end bearings flush with the headplate bearing shoulders using proper drivers. On 6" & 7" UNIVERSAL RAI®, install thrust washer (29) in bearing bores then install gear end bearings so that they protrude ½6" (1.6mm) above headplate surface.
- 13. Install bearing clamp plates (34). On 6" & 7" UNIVERSAL RAI®, impeller end clearances are also to be set during this step. Install clamp plates (34) with capscrews (31) making sure that the gap between the clamp plates and the headplate is even all around, at the same time, set end clearances per Table 5.
- 14. Install gears and time impellers as in (A).
- 15. For setting end clearances on 2½-5" gear diameter units, special tools, thrust adjuster fork Fig. 7 and thrust adjuster saddle Figure 8 are required. Refer to Fig. 6 for installation of tools. The flat side of the saddle rests against the bearing inner race and the flat side of the fork rests against the back side of the gear. Install a shim, with thickness equal to gear end clearance (Table 6), between the impeller and the gear end headplates. Tap on top of the fork until the shim becomes snug. Remove the shim and check end clearances. To increase gear end clearance, tap on the end of the gear end shaft with

- a soft metal mallet. On units, UNIVERSAL RAI®, set end clearances for 6" & 7" by turning capscrews (31) evenly in or out.
- 16. Install drive end cover (5) after packing bearing cavities with suitable grease. Replace drive shaft seal. Lip must point toward (33) the bearing. Exercise care not to damage the lip as it passes over shaft keyway.
- 17. Install gasket item (7). Install the gear house after cleaning out the inside. Tighten gear box cap screws (23) evenly. Fill with correct grade of oil until oil flows out through oil level hole. Grease drive and bearings. (See Lubrication.)
- 18. Reinstall coupling or belt sheave making sure that they have a slight slide fit with the shaft and could be installed by hand.

Where repairs involve parts replacement, it is recommended that Factory Parts be used to insure fit and suitability. Delay in making such repairs can be reduced by having spare parts on hand.

When ordering parts, please furnish all information from the blower nameplate.

Repairs or adjustments to blowers should be performed by personnel with a good back ground of general mechanical experience and the ability to follow the detailed instructions in this manual. No special tools are required. Some operations involve extra care and a degree of precision work. This is especially true in timing impellers, and in handling bearings. Experience indicates that a high percentage of bearing failures is caused by dirt contamination before or during assembly. Therefore, clean the work area before starting disassembly, and protect new or reuseable parts during progress of the work. (See page 23 for Repair Kit Information.)

INTERNAL CLEARANCES

References to operating clearances in this manual include only one mention of the specific amount of clearance to be used or expected. For units in good condition this information is not essential in field service work. Situations may arise, however, when it is desirable to compare existing clearances with the correct Engineering values or to reestablish clearances.

Listed in Table 6 are the ranges of impeller clearances used in factory assembly of normal UNIVERSAL RAI® blowers. It should be kept in mind that clearances may change slightly in service, but should never be less than the minimum values listed. Only well qualified personnel should attempt to measure clearances for direct comparison with this data.

Table 6 — Normal Clearances for UNIVERSAL RAI® Blowers — Inches (MM)

	IMPELLER ENDS		CYLINDER		IMPELLER	
SIZE	TOTAL	DRIVE END MINIMUM	GEAR END MINIMUM	INLET & DISCHARGE	CENTER	FRONTS BACKS
22	.006/.100 (.1525)	.003 (.08)	.003 (.08)	.004/.005 (.113)	.002/.003 (.0508)	.007/.01 (.1825)
24	.006/.100 (.1525)	.003 (.08)	.003 (.08)	.004/.005 (.113)	.002/.003 (.0508)	.007/.01 (.1825)
32	.006/.011 (.1528)	.003 (.08)	.003 (.08)	.004/.006 (.1015)	.002/.003 (.0508)	.01/.012 (.2530)
33	.006/.011 (.1528)	.003 (.08)	.003 (.08)	.004/.006 (.1015)	.002/.003 (.0508)	.01/.012 (.2530)
36	.006/.011 (.1528)	.003 (.08)	.003 (.08)	.004/.006 (.1015)	.002/.003 (.0508)	.01/.012 (.2530)
42	.008/.011 (.2028)	.004 (.10)	.004 (.10)	.005/.007 (.1318)	.003/.004 (.0810)	.009/.012 (.2330)
45	.008/.013 (.2033)	.004 (.10)	.004 (.10)	.005/.007 (.1318)	.003/.004 (.0810)	.012/.015 (.338)
47	.008/.013 (.2033)	.004 (.10)	.004 (.10)	.005/.007 (.1318)	.003/.004 (.0810)	.012/.015 (.338)
				: -		
53	.008/.011 (.2028)	.004 (.10)	.004 (.10)	.005/.008 (.1320)	.003/.004 (.0810)	.011/.013 (.2833)
56	.008/.013 (.2033)	.004 (.10)	.004 (.10)	.005/.008 (.1320)	.003/.004 (.0810)	.015/.017 (.3843)
59	.008/.013 (.2033)	.004 (.10)	.004 (.10)	.005/.008 (.1320)	.003/.004 (.0810)	.015/.017 (.3843)
65	.012/.016 (.3040)	.008 (.20)	.004 (.10)	.006/.008 (.152)	.006/.008 (.1520)	.010/.014 (.2536)
68	.014/.018 (.3646)	.010 (.25)	.004 (.10)	.006/.008 (.152)	.006/.008 (.1520)	.010/.014 (.2536)
615	.014/.018 (.3646)	.010 (.25)	.004 (.10)	.006/.008 (.152)	.006/.008 (.1520)	.010/.014 (.2536)
				·		
76	.012/.016 (.3040)	.008 (.13)	.004 (.10)	.006/.008 (.152)	.006/.008 (.1520)	.013/.015 (.3338)
711	.014/.018 (.3646)	.010 (.25)	.004 (.10)	.006/.008 (.152)	.006/.008 (.1520)	.013/.015 (.3338)
718	.014/.018 (.3646)	.010 (.25)	.004 (.10)	.006/.008 (.152)	.006/.008 (.1520)	.013/.015 (.3338)

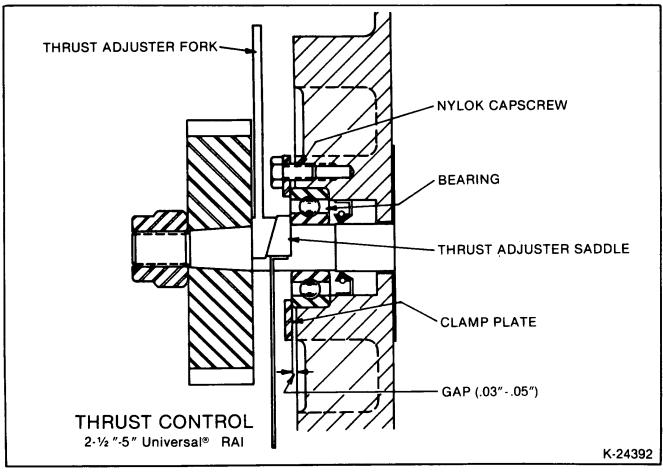


Figure 6 — Thrust Setting, 21/2 "-5" UNIVERSAL RAI®

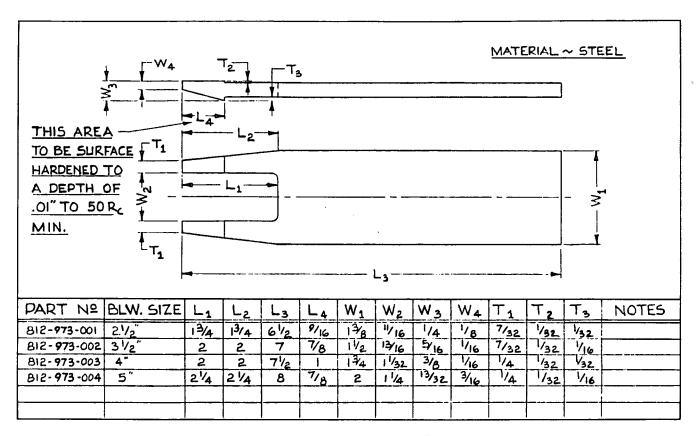


Figure 7 — Thrust Adjuster Fork

812-973

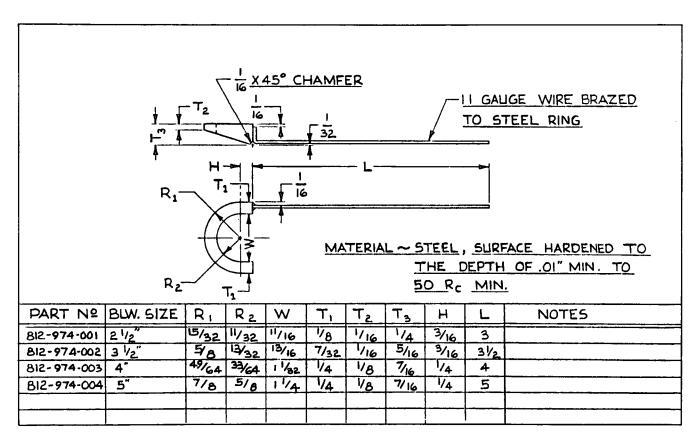


Figure 8 — Thrust Adjuster Saddle

812-974

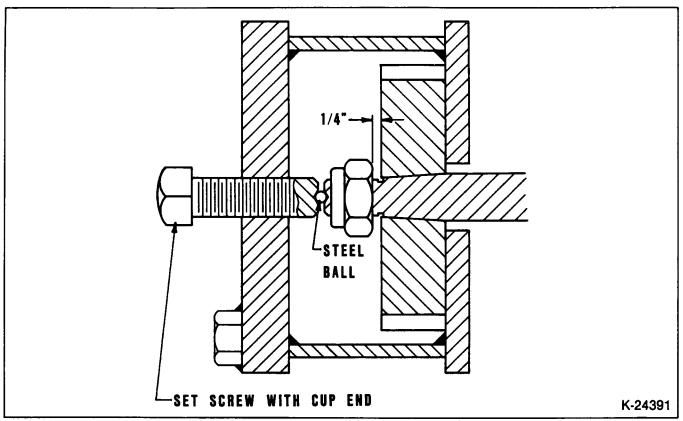


Figure 9 — Gear Removal

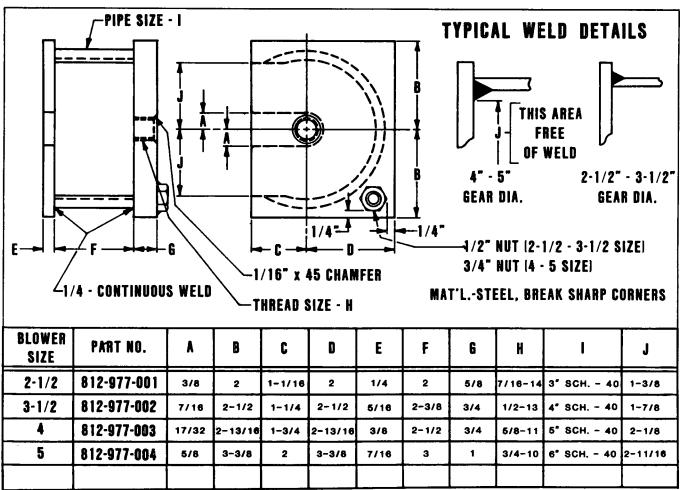


Figure 10 — Gear Pullers for UNIVERSAL RAI® with Tapered Gear Bores

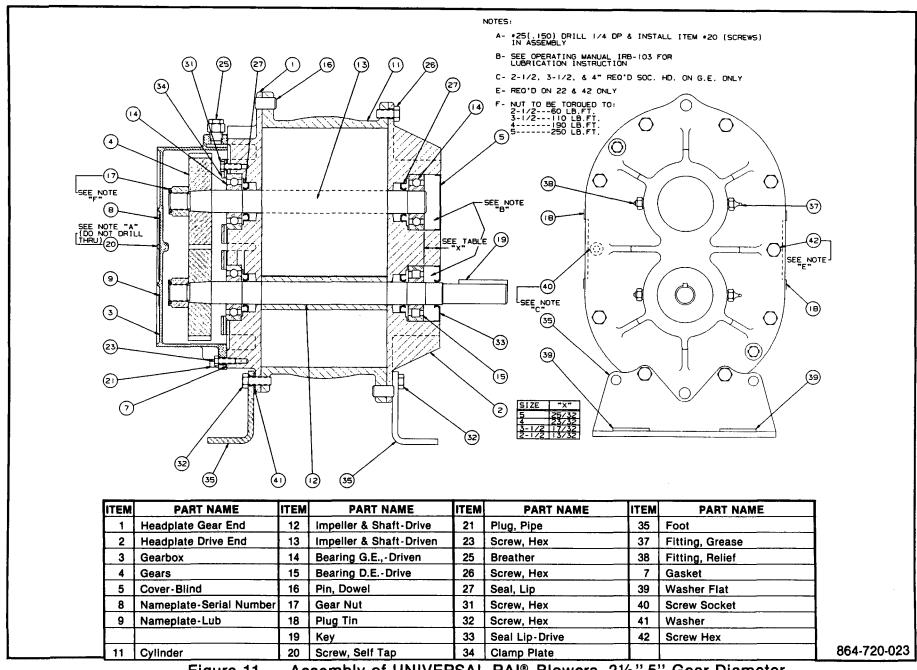


Figure 11 — Assembly of UNIVERSAL RAI® Blowers, 21/2"-5" Gear Diameter

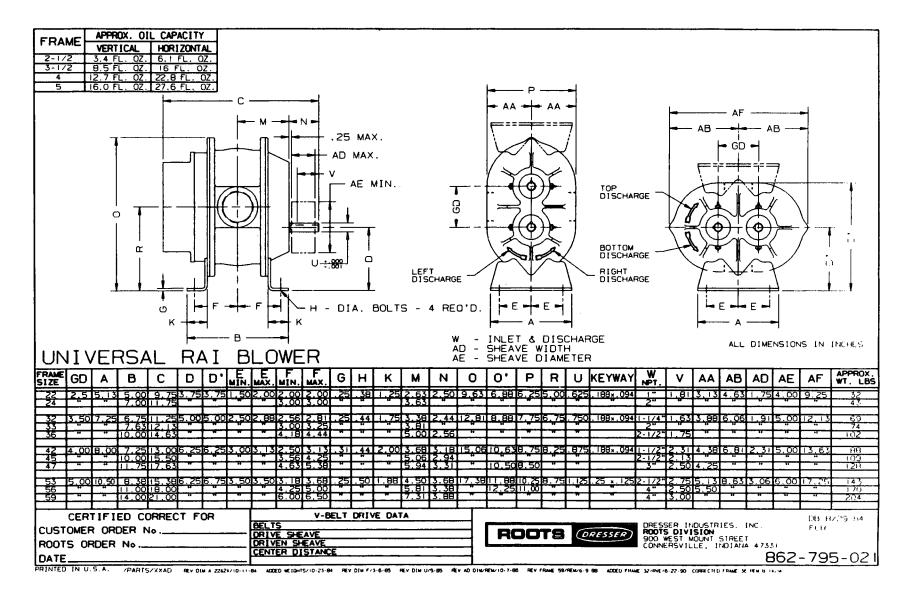


Figure 12 — Dimensional Assembly of UNIVERSAL RAI® Blower (21/2"-5")

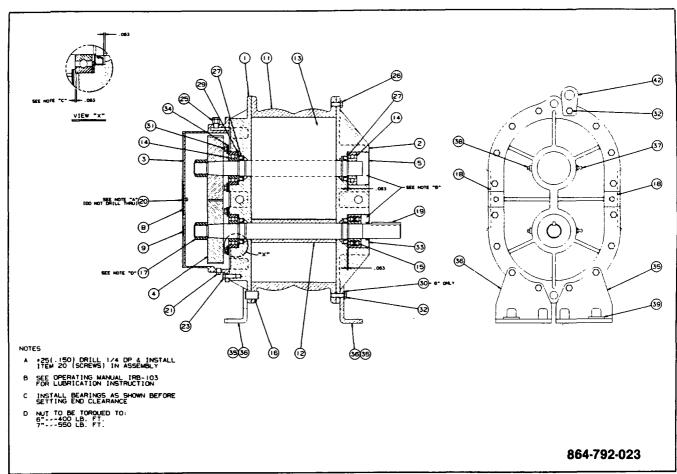


Figure 13 — Assembly of UNIVERSAL RAI® Blowers, 6" and 7" Gear Diameter

PARTS LIST FOR 6"-7" UNIVERSAL RAI®

ITEM	PART NAME	ITEM	PART NAME	ITEM	PART NAME	ITEM	PART NAME
1	Headplate - G.E.	13	Imp & Shaft - Drvn	25	Plug - Vent	36	Foot - Lt. Hand
2	Headplate - D.E.	14	Bearing, Ball	26	Screw, Cap - Hex	37	Fitting, Grease
3	Gearbox	15	Bearing, Roller	27	Seal, Lip	38	Plug - Vent
4	Gear Assembly	16	Pin, Dowel	29	Washer - Wavy Spr.	39	Washer - Oblong
5	Plug - Opening	17	Nut, Stop - Hex	30	Washer	40	Pipe - Tbe. (Close)
7	Gasket, Gearbox	18	Plug - Opening	31	Screw, Cap Hex	41	Coupling - Pipe
8	Nameplate - S/N	19	Key, Square	32	Screw, Cap Hex	42	Lifting Lug
9	Nameplate - Lube	20	Screw, Rd. Hd.	33	Seal, Lip		
11	Cylinder	21	Plug, Pipe - Sq. Hd.	34	Brg. Clamp Plate		
12	Imp & Shaft — Drive	23	Screw, Cap - Hex	35	Foot - Rt. Hand		

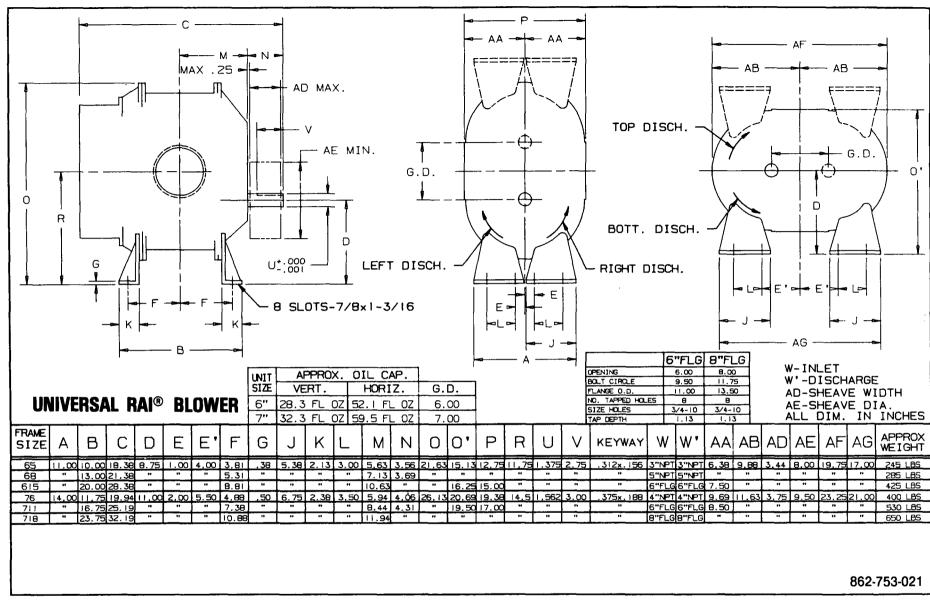


Figure 14 — Dimensional Assembly of UNIVERSAL RAI® Blower (6" & 7")

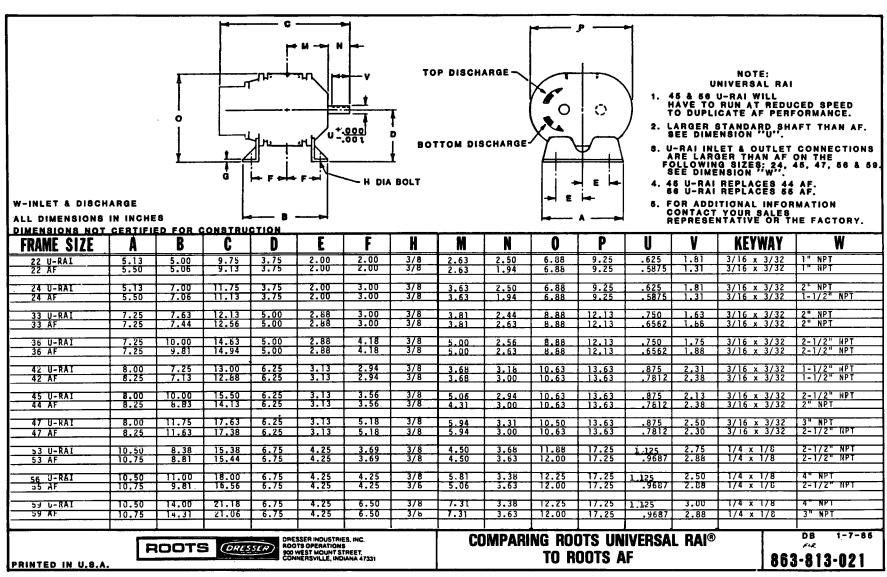


Figure 15

Major Changes when Replacing AF with UNIVERSAL RAI® Blower

Size & Type	Sheave Bushing Dia.	Inlet Size	Disch. Size	Mounting Feet
22 UNIVERSAL RAI®	.625**	1"	1''	Interchangeable
22 AF	.5875``	1"	1''	
24 UNIVERSAL RAI®	.625``	2	2	Interchangeable
24 AF	.5875``	1 1/2	1 1/2 "	
32 UNIVERSAL RAI®	.750''	1¼"	1¼"	Special Feet
315 AF	.6562''	3/4"	3/4"	•
33 UNIVERSAL RAI®	.750``	2	2	Interchangeable
33 AF	.6562''	2"	2"	
36 UNIVERSAL RAI®	.750``	21/2	21/2	Interchangeable
36 AF	.6562''	21/2"	21/2"	
42 UNIVERSAL RAI®	.875``	11/2"	11/2	Interchangeable
42 AF	.7812''	11/2"	11/2"	G
45 UNIVERSAL RAI®	.875''	21/2"	21/2	Reverse Feet
44 AF	.7812''	2"	2"	
47 UNIVERSAL RAI®	.875''	3	3,,	Interchangeable
47 AF	.7812''	21/2"	21/2"	
53 UNIVERSAL RAI®	1.250"	21/2	21/2**	Special Feet
53 AF	.9687``	21/2"	21/2"	
56 UNIVERSAL RAI®	1.250"	4	4"	Special Feet
55 AF	.9687``	21/2"	21/2"	
59 UNIVERSAL RAI®	1.250"	4"	4"	Special Feet
59 AF	.9687``	3	3"	

^{*}To maintain AF performance with UNIVERSAL RAI®, the blower speed will have to be reduced by sheave change. See Fig. 15 drawing for your specific blower size.

CAUTION CAUTION CAUTION

MAKE CERTAIN THAT THE BREATHER IS LOCATED ON TOP AND THE DRAIN PLUG IN THE BOTTOM OF THE GEAR BOX.

GENERAL TERMS

CONTRACT PERFORMANCE, INSPECTION AND ACCEPTANCE A. Unless Seller specifically assumes installation, construction or start-up responsibility, all products shall be finally inspected and accepted within thirty (30) days after receipt at point of delivery. Products not covered by the foregoing and all work shall be finally inspected and accepted within thirty (30) days after completion of the applicable work by Seller. All claims whatsoever by Buyer (including claims for shortages) excepting only those provided for under the WARRANTY AND LIMITATION OF LIABILITY and PATENTS Clause hereof must be asserted in writing by Buyer within said thirty (30) day period or they are waived. If this contract involves partial performance, all such claims must be asserted within said thirty (30) day period for each partial performance. There shall be no revocation of acceptance.

Rejection may be only for defects substantially impairing the value of products or work and Buyer's remedy for lesser defects shall be those provided for under the WARRANTY AND LIMITATION OF LIABILITY Clause.

B. Seller shall not be responsible for nonperformance or delays in performance occasioned by any causes beyond Seller's reasonable control, including, but not limited to, labor difficulties, delays of vendors or carriers, fires, governmental actions and material shortages. Any so occasioned shall effect a corresponding extension of Seller's performance dates which are, in any event, understood to be approximate. In no event shall Buyer be entitled to incidental or consequential damages for late performance or a failure to perform.

TITLE AND RISK OF LOSS

Full risk of loss (including transportation delays and losses) shall pass to the Buyer upon delivery of products to the f.o.b. point or if Seller consents to a delay in shipment beyond the contract date at the request of the Buyer, upon notification by the Seller that the products are manufactured.

WARRANTY AND LIMITATION OF LIABILITY

A. Seller warrants that its products and parts, when shipped, and its work (including installation, construction and start-up), when performed will meet all applicable specifications and other specific product and work requirements (including those of performance), if any, of this agreement, will be

of good quality and will be free from defects in material and workmanship. All claims for defective products or parts under this warranty must be made in writing immediately upon discovery and, in any event, within eighteen (18) months after installation (not to exceed twenty-four [24] months after shipment) of the applicable item and all claims for defective work must be made in writing immediately upon discovery and in any event within eighteen (18) months after installation (not to exceed twenty-four [24] months after shipment) of completion thereof by Seller. Defective items must be held for Seller's inspection and returned to the original f.o.b. point upon request. THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS.

B. Upon Buyer's submission of a claim as provided above and its substantiation, Seller shall at its option either (i) repair or replace the unit claimed defective within the warranty period defined above, regardless of cause of failure EXCEPT shipping damage, vandalism or mishandling, i.e. dropping or other external impact damage, at the original f.o.b. point of delivery, or (ii) refund an equitable portion of the purchase price.

Seller reserves the right to withdraw the Uncontested Warranty where evidence indicates repeated failures are due to misapplication, abuse, or operation not in accordance with Roots operating instruction bulletin.

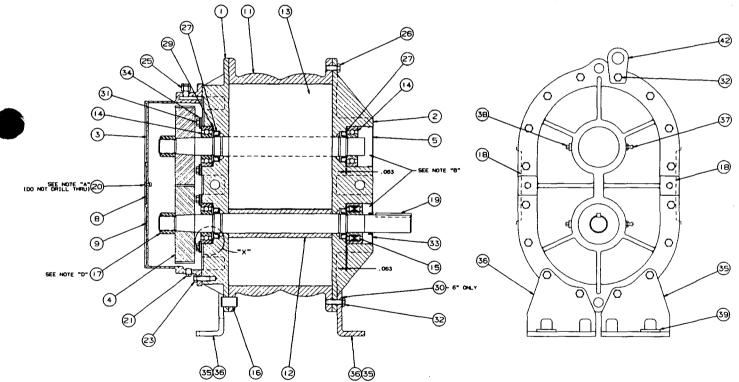
Specifically understood that products sold hereunder are not warranted for operation with erosive or corrosive fluids or those which may tend to build-up within the product quoted. No product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action of any fluid and Buyer shall have no claim whatsoever against Seller therefore, nor for problems resulting from build-up of material within the unit.

D. The foregoing is Seller's only obligation and Buyer's only remedy for breach of warranty, and except for gross negligence, willful misconduct and remedies permitted under the CONTRACT PERFORMANCE, INSPECTION AND ACCEPTANCE and the PATENTS Clause hereof, the foregoing is Buyer's only remedy hereunder by way of breach of contract, tort or otherwise. In no event shall Buyer be entitled to incidental or consequential damages. Any action for breach of this agreement must commence within two (2) years after the cause of action has accrued.

REPAIR KIT INFORMATION

UNIVERSAL RAI®					
REF. NO. QTY. PART DESCRIPTION REPAIR KIT PART				IT PART NOS.	
4	1 Pr.	Timing Gear	FRAME SIZE	REPAIR KIT NO	
5	1_	Plug — Opening	2"	65-101-ORK	
7	1	Gasket	3″	65-104-ORK	
14	1	Bearing, D.E. — DRVN	4"	65-107-ORK	
14	2	Bearing, G.E.	5″	65-111-ORK	
15	1	Bearing, Dr. Shaft	*6"	65-115-ORK	
17	1	Gear Nut	*7"	65-119-ORK	
27	2	Seals, D.E.			
27	2	Seals, G.E.			
31	4	Capscrew — Selflock			
33	1	Seal — Dr. Shaft			

*Repair kits for the 6" and 7" UNIVERSAL RAI® do not contain gears.



SEE BACK COVER FOR NEAREST DISTRIBUTOR.

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*Tate Eastern Shore (E07)
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Delmar, MD 21875
410/546-3293
Fax: 410/546-3461

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Craun-Liebing Company (M06) 11801 Clifton Blvd. Cleveland., OH 44107 216/228-7900 Fax: 216/228-7905

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* SYTEK, IEM Div. (M14) 5100 Duff Drive Cincinnati, OH 45246 513/874-5840 800/447-8962 Fax: 513/874-5508

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*Wascon, Inc. (\$12) Route 4, Box 176 Livingston, TN 38570 615/823-1388 Fax: 615/823-4924

TEXAS

*AAS/UNIMAC (S04) Sales Office 13733 Omega Road Dallas, TX 75244 214/701-0400 214/701-0400 Fax: 214/385-0936 Shipping/Billing 13717 Neutron Road Dallas, TX 75244 Fax: 214/448-2625 rax: 214/448-2625 Air Mac Inc. (\$01) 2104 Menton Place Carrollton, TX 75006 214/416-1126 Fax: 214/416-7486 **Allen-Stuart Equipment Co. (S13) 12101 FM 529 Houston, TX 77041 713/896-6510 Fax: 713/896-1693 * Dallas Compressor (S04) 13645 Omega Dallas, TX 75244 214/233-9870 Fax: 214/233-1878

res: 214/23-18/8 Dixie Supply Air & Pump Co. (S06) 585 South Padre Island Dr. Corpus Christi, TX 78405 512/289-7000 Fax: 512/289-9071

Duncan Equipment Co. (\$07) 3511 N. Central Freeway Wichita Falls, TX 76306 817/855-6110 Fax: 817/855-0849

UTAH

Compressor Pump & Service, Inc. (W05) 3333 West 2400 South Salt Lake City, UT 84119 801/973-0154 Fax: 801/973-9546

VIRGINIA

Clinch River Corp. (£06) Route 6, Box 60 Tazewell, VA 24651 703/988-2548 Fax: 703/988-9325 rax. 1/J/1905/3427
P.O. Box 547
East Patricia Ann Lane
Appomatrox, VA 24522
804/352-2095
Fex: 804/352-0795

*Engineered Systems & Products, Inc (E09) 8130 Virginia Pine Court Richmond, VA 23237 804/271-7200 Fax: 804/271-8317

WASHINGTON

*Rogers Machinery Co., Inc. (W09) P.O. Box 548 3409 Galvin Road Centralia, WA 98531 206/736-9356 Fax: 206/736-8630 Pas: 206/765-050 *Rogers Machinery Co., Inc. (W09) 7800 Fifth Avenue South Seattle, WA 98108 206/763-2530 Fas: 206/763-1187 *Rogers Machinery Co., Inc. (W09) Spokane Industrial Park East 16615 Euclid Avenue Spokane, WA 99216 509/922-0556 Fax: 509/922-0910

WEST VIRGINIA

Guyan Machinery Co. (E10) P.O. Box 150 Chapmanville, WV 25508 304/855-4501 Fax: 304/855-8601

West Virginia Pumps/Goulds Pumps (E16) 20 East 24th Street Huntington, WV 25721 304/529-4161 Fax: 304/522-9361

WYOMING

*Compression & Components Co., Inc. (W04) P.O. Box 879 (82644) 1907 Salt Creek Highway Mills, WY 82604 307/235-4700 Fax: 307/235-3028

CANADA

CANADA

*A. G. Dunbar Co., Ltd. (C01)

10 Morris Drive, Unit 9

Burnside Industrial Park

Dartmouth, Nova Scotia B38 1K8

902/468-7177

Fax: 902/468-3157

* Beckland Equipment Ltd. (W03) 3250 Beta Avenue Burnaby, B.C. V5G 4K4 604/299-8808 Fax: 604/299-6162

** Authorized for 10" and above

*Canadian Air Compressor Ltd. (C02) 1875 Industrial Boulevard Laval, Quebec H7S 1P5 514/669-9117 Fax: 514/334-3138 * Canadian Air Compressor, Ltd. (C02) 57 Atomic Avenue Toronto, Ontario M8Z 5K8 416/252-9505 800/387-7270 Fax: 416/252-9228 **Profew-Scott Limited (C03) 1515 Matheson Boulevard, Unit C-1 Mississauga, Ontario L4W 2P5 416/624-6330 Fax: 416/624-7590

Prolew-Scott Limited (C03) 5859 CH St. Francois Montreal, Quebec H4S 186 514/336-5661 Fax: 514/336-1158 AUSTRALIA

Godfrey Howden Pty. Ltd. P.O. Box 84 r.u. sox 84 Niddrie, Victoria 3042, Australia 011-61-3-338-3811 Fax: 011-61-3-338-6136

WEST INDIES Engineering Agencies, Ltd. 11 Borde Street Port of Spain, Trinidad, West Indies 809/625-3043 809/625-3160 Fav: 809/627-0880

ROOTS' AUTHORIZED TRUCK BLOWER DISTRIBUTOR LIST

Canadian Air Compressor, Ltd. 57 Atomic Avenue Toronto, Ontario M8Z 5K8, Canada 416/252-9505 800/387-7270 Fax: 416/252-9228

Don Johns Inc. 1312 West Lake Street Chicago, IL 60607 312/666-2210 Fax: 312/666-0777 Girard Equipment, Inc. P.O. Box 302-8 1004 Route 1 Rahway, NJ 07065 908/382-4600

800/526-4330 Fax: 908/382-4650 H.N.L. Corporation 304 Leominster Road Sterling, MA 01564 508/422-6222 508/422-64R6 Fax: 508/422-8217

Haygood of Atlanta, Inc. 4325 Moreland Avenue P.O. Box 749 Conley, GA 30027-0749 404/366-4644 R00/999-04R3

Fax: 404/362-3591 Branches: Birmingham, AL 800/999-6532 800/777-2119 Ft. Smith, AR Little Rock, AR Springdale, AR Orlando, FL 800/999-88 800/888-3150 800/999-8281 800/456-3099 800/444-7495 800/456-6110 Hammond, LA Greenville, MS Jackson, MS Chattanooga, TN Knoxville, TN Memphis, TN Nashville, TN 800/888-6476 800/444-9942

Haygood, Inc. 7901 Ambassador Row Dallas, TX 75247 800/888-9791

Joint Clutch & Gear Service, Inc. 703 Marquette Avenue Bay City, MI 48706 517/686-2924 ax: 517/686-9906

Branches: Detroit, MI Detroit, MI 313/961-4460 Fax: 313/961-4609 Grand Rapids, MI 616/538-7390

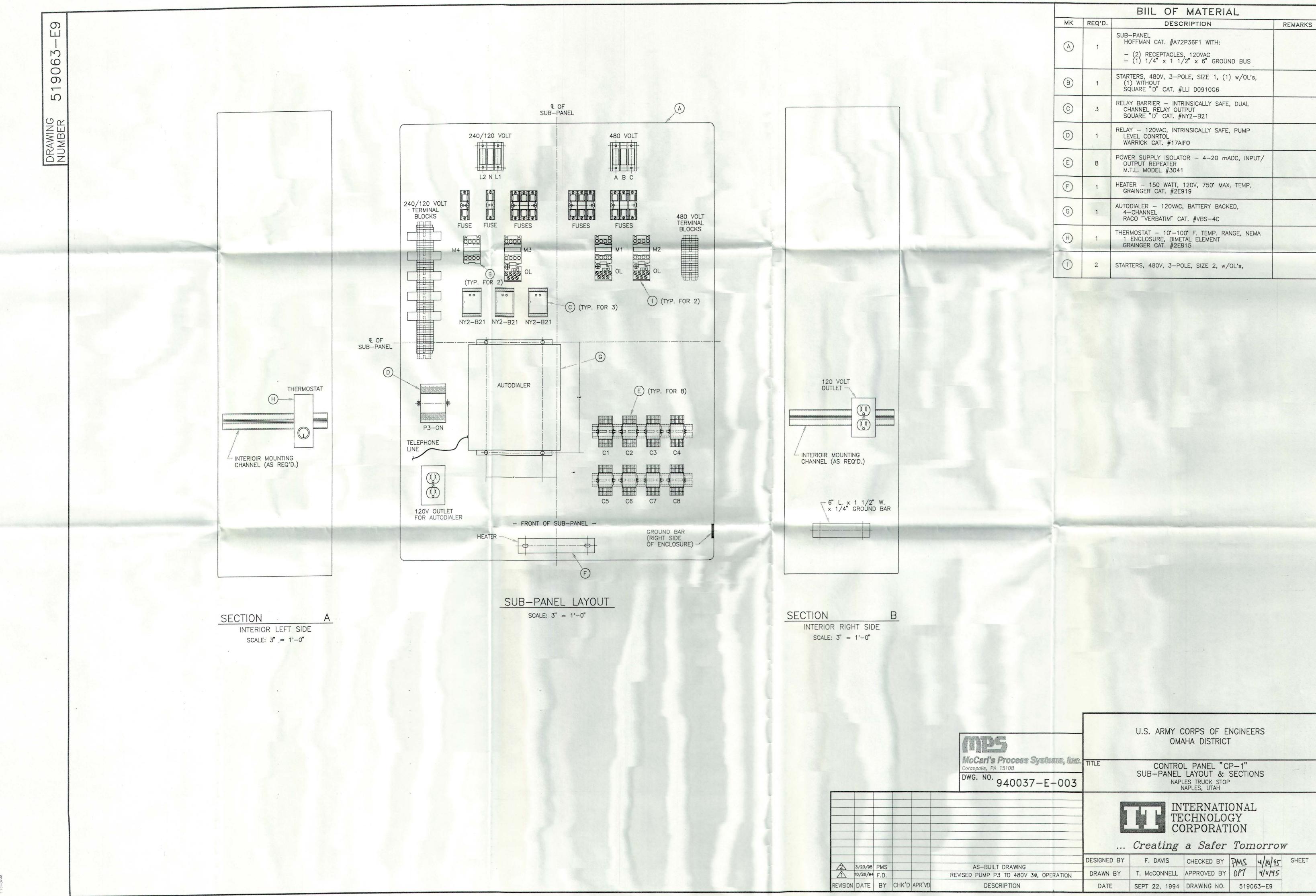
The Power Train Co.'s 2334 Production Drive P.O Box 41280 Indianapolis, IN 46241 317/241-9393 800/999-3912 Fax: 317/243-1433

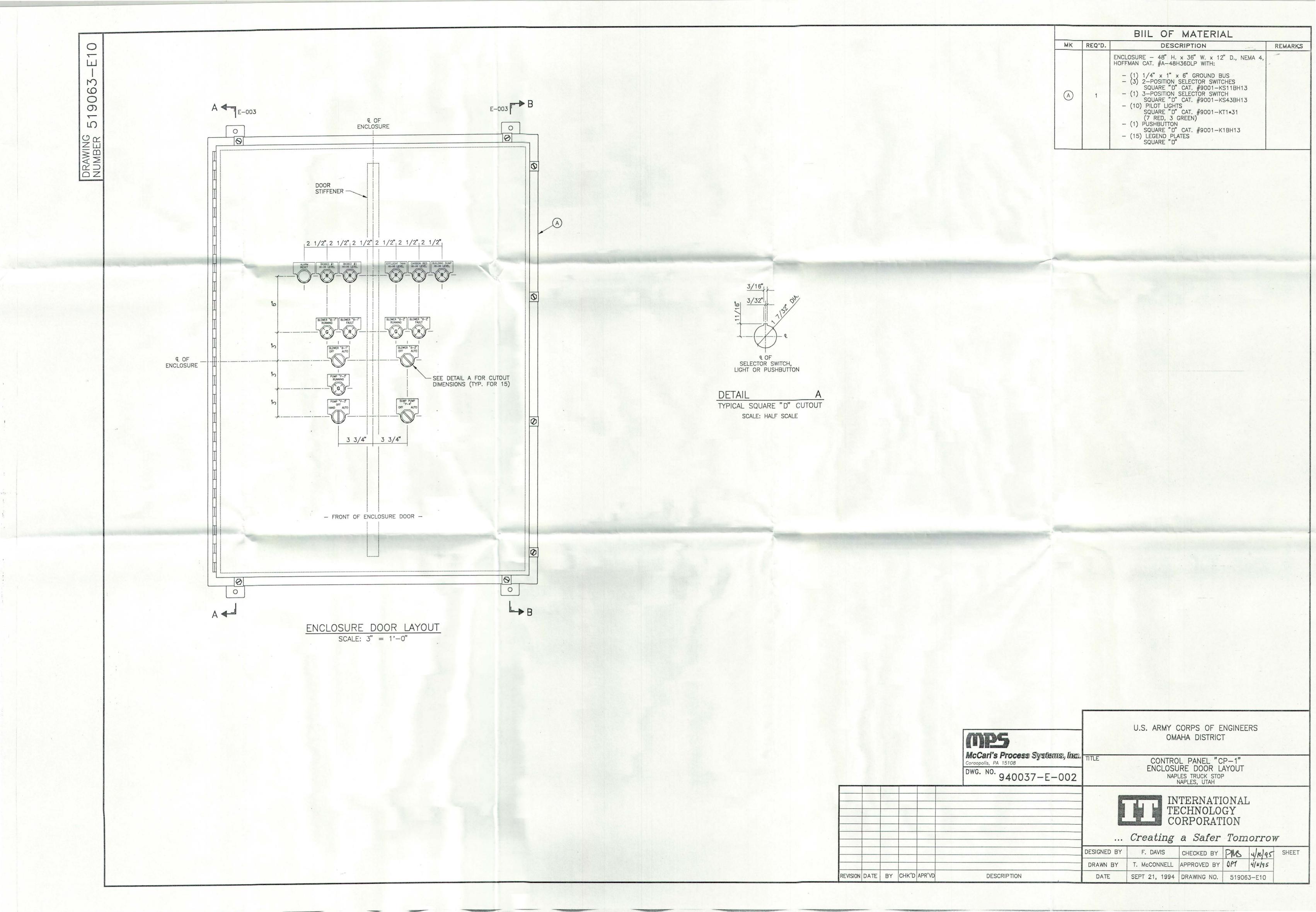
> anches: Fort Wayne, IN Lafayette, IN Richmond, IN 800/999-3218 800/999-1098 800/999-0288 800/999-5707 Elizabethtown, KY Lexington, KY Louisville, KY 800/999-6529 800/999-8972 Cincinnati, OH

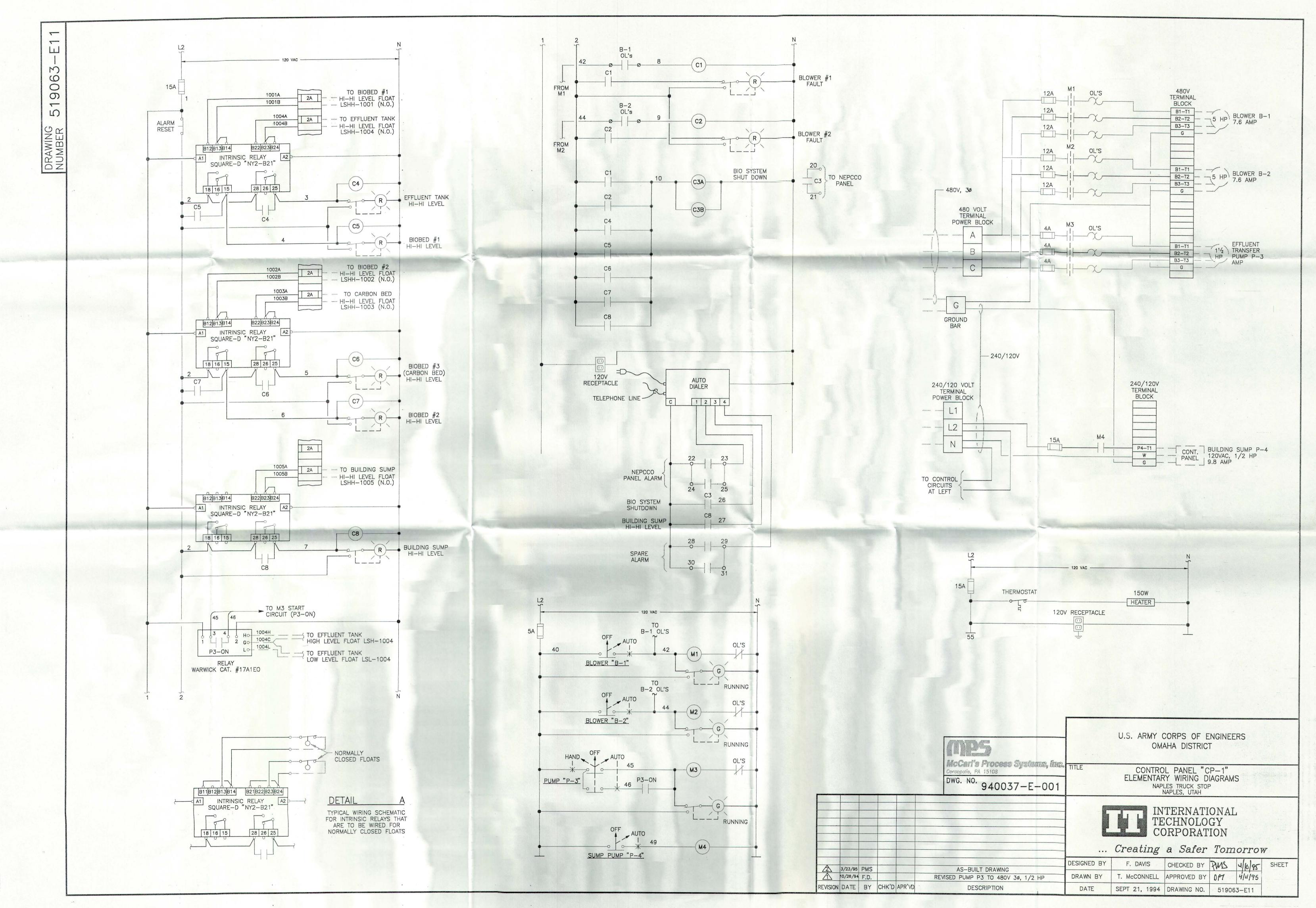
R & M Mobile Power Co. 915 Madison Avenue P.O. Box 920 Valley Forge, PA 19481 215/666-0678 800/962-0670 Fax: 215/666-1766

Trans-Spec Co. 14852 Columbia Jumbiana-Can. Columbiana, OH 44408 216/482-5536 a-Canfield Road APPENDIX C-3

Control Panel CP-1







APPENDIX C-4 Autodialer

Autodialer Phone No.: (801) 781-2139

Lerbatim OWNER'S MANUAL



RACO MANUFACTURING & ENGINEERING, CO. 1400 62nd Street, Emeryville, CA 94608 (510) 658-6713 1-800-722-6999 FAX # 1-510-658-3153

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KEEP THIS FOR YOUR RECORDS

LIMITED WARRANTY

WARRANTY CERTIFICATE

Raco Manufacturing and Engineering Co Inc., Emeryville California warrants this product to be in good working order for a period of five years from the date of purchase as a new product. In the event of failure of any part(s), due to defect in material or workmanship occurring within that five year period, Raco will, at its option, repair or replace the product at no charge for parts or labor. Any alteration of the product without instruction from Raco's Engineering Department will automatically void this warranty. If alterations of the unit are authorized by Raco, please complete the authorization form in the Owners Manual and return the form to Raco to ensure the warranty. Under no circumstances will Raco be responsible for consequential or secondary damages.

The defective product should be returned, insured and freight prepaid, securely packaged to the address listed below. Please call 1-800-722-6999 for a Return Authorization Number. Please include a copy of your sales receipt, the dialers serial number, and a detailed description of the problem you are experiencing.

Raco Manufacturing and Engineering Co Inc. Service Department 1400 62nd Street Emeryville, CA 94608

Detach here before mailing

WARRANTY REGISTRATION

Title/Position

Company/Organization

Name

IMPORTANT: Within 14 days of purchase, please compete this Warranty Registration. Detach the top portion, fold in half and drop in the mail. Postage is paid if mailed in the US. Otherwise, please return to:

Raco Manufacturing and Engineering Co Inc. 1400 62nd Street Emeryville, CA 94608

יוע	ision/Department
Ad	dress
Tel	ephone
Dea	aler's Name
Ad	dress
	e following additional information will assist us in our continuing efforts to wide you with products that meet your specific requirements.
	This autodialer is used in:wastewater,gas pipeline,remote equipmentcold storage,chemical manufacture,energy generation,agriculture,other.
	It uses the following types of transducers:pressure,temperature,flow,electrical detection,gas (all types),intrusion,float level,other.
	I first became aware of this autodialer from:dealer showroom, colleague,trade show,professional association,magazine inquiry,other.
4_	I read the following publication(s) regularly:

Extended Warranty



REMOTE ALARMS AND CONTROLS

RACO Manufacturing and Engineering Co., 1400 62nd St., Emeryville, CA 94608 (510) 658-6713 800-722-6999 FAX (510) 658-3153

.: '--

DIALER SPECIFICATION - VERBATIM® MODULAR SERIES VSS July 15, 1992

<u>Description & Phone Number Dialing:</u>

The dialer shall be a solid state component capable of dialing up to 16 phone numbers, each up to 24 digits in length. Phone numbers and Standard pulse dialing or Touch Tone DTMF dialing are user programmable via the system's keyboard or Touch Tone phone.

Solid State Voice Message Recording and Playback:

The unit shall have two different categories of speech message capability, all implemented with permanent nonvolatile solid state circuitry with no mechanical tape mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel.

<u>User Field Recorded Messages</u>: The user may record and re-record his own voice messages, for each input channel and for the Station ID.

- There shall be no limit on the length of any particular message, within the overall available message recording time, which shall be 40 seconds for 4 channel units; 80 seconds for 8 channel units, and 160 seconds for 16 or more channels.
- The unit shall allow selective recording of both Normal and Alarm advisory messages for each input channel.
- The unit shall provide for <u>automatic setting</u> of the optimum speech memory usage rate for the total set of messages C. recorded, in order to achieve optimum recording sound quality.

Circuit board switches or jumper straps shall not be acceptable means of manipulating message length or recording rates.

Permanent Resident Non-Recorded Messages: Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of his own.

Local & Remote Programming Capabilities:

- The user may optionally elect to alter the following parameters from their standard normal default values via keyboard entry or remotely from any Touch Tone phone.
- Alarm Call Grouping: On alarm, system shall selectively call the correct phone numbers according to the current alarm(s).
- Alarm response delay: .1 to 999.9 seconds.
- Delay between alarm call outs: .1 to 99.9 minutes.
- ** Alarm reset time: 0.1 to 99 hours or "NO RESET".
- Incoming ring response (answer) delay: 1 to 20 rings.
 - Number of message repetitions: 1 to 20 repetitions.
- Input alarm criteria: Each channel shall be independently configured for "Alarm On Open Circuit", "Alarm On Closed Circuit", "No Alarm".

Autocall Test: When enabled, the unit shall place a single round of test calls, both at the time this function is enabled and also at regular subsequent intervals until this function is disabled at the keyboard.

Run Time Meter: Selected inputs shall accumulate and report the number of hours that its input contacts have been closed.

Remote system microphone activation.

Remote and local arming and disarming of system.

Pulse Totalizer Function.

Nonvolatile Program Memory Retention:

User-entered programming and voice messages shall be kept intact even during power failures or when all power is removed for up to ten years.

Acknowledgement:

Acknowledgement of an alarm phone call is to be accomplished by pressing a Touch Tone® "9" as the alarm call is being received, and/or by returning a phone call to the unit after having received an alarm call.

The unit shall continuously monitor the presence of AC power and the status of four contact closure inputs. Unit shall optionally be field upgradeable to incorporate a total of 8, 16, 24, or 32 dry contact inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs. Unit shall, upon a single program entry, automatically accept all input states as the normal non-alarm state, eliminating possible confusion about Normally Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently "Open Circuit" or "Closed Circuit," without disturbing any message programming. Each input channel shall also be independently programmable, without need to manipulate circuit board switches or jumpers, as Normally Open or Normally Closed, or for No Alarm (Status Only), or for Pulse Totalizing, or for Run Time Metering.

Run Time Meter Inputs:

7. Any dry contact input can be programmed to accumulate and report the number of hours their respective input circuits have been closed. Any such channels will never cause an alarm, but on inquiry will recite the channel's message according to the status of the input and then report the closed circuit time to the tenth of an hour. The input will accumulate and report in tenths of hours up to a total accumulated running time of 99,999.9 hours. The initial value of the Run Time Meter shall be programmable in order to agree with existing electromechanical Run Time Meters. Up to a total of 8 Run Time Meters may be programmed.

Pulse Totalizer Inputs:

Any dry contact input can be programmed to accumulate the number of pulses (momentary contact closures) occurring at the input.

Alarm Message:

 Upon initiating an alarm phone call, the system is to "speak" only those channels that are currently in "alarm status".

Diagnostics:

10. The unit shall provide a complete verbal report of all programmable functions and their programmed values on command form any remote Touch Tone phone.

Speakerphone:

11. The unit shall be capable of dialing any phone number on command and function as a speakerphone.

Inquiry Message and Function:

12. Inquiry phone calls can be made directly to the unit at any time from any telephone, locally or long distance, for a complete status report of all variables being monitored, including power status.

Power Battery Backup:

13. Normal power shall be 105-135 VAC, 15 watts nominal. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is present. The system shall operate on battery power for a minimum of 20 continuous hours in the event of AC power failure. A shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger," in order to minimize recharge time and maximize battery life available.

Phone Line:

14. The dialer is to use a standard rotary pulse or Touch Tone "dial-up" phone line (direct leased line <u>not</u> to be required) and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ-11).

Integral Surge Protection:

15. All power, phone line, dry contact, and analog signal inputs shall be protected at the circuit board to IEEE Standard 587, category B (6,000 volts open circuit/3,000 amps closed circuit). Gas tubes followed by solid state protectors shall be integral to the circuit board for each such line. Protectors mounted external to the main circuit board shall not be an acceptable substitute. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

Warranty:

16. The dialer shall be covered by a three (3) year warranty covering parts and labor performed at the Factory.

Modular Upgrades:

17. The system shall-include expansion connectors to accommodate field upgrades for additional dry contact inputs, remote supervisory control outputs, analog inputs and communication with remote printers and computers.

Additional Features: Sealed Switches, LED Indicators, Alarm Disable Warning, TalkThrough:

18. All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation, Program Mode, Phone Call in Progress, Status for each channel, AC Power Present, AC Power Failure, and Low, Discharging or Recharging Battery. On any Inquiry telephone call or On Site status check, the voice shall provide specific warning if no dialout phone numbers are entered, or if the unit is in the "alarm disable" mode, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote phone to listen to local sounds and have a two-way conversation with personnel at the dialer.

Special Order Items:

- 19. The following options shall be available on specific order:
 - a) NEMA 4X (sealed) enclosure.
 - b) Remote supervisory control (4 or 8 outputs).
 - c) 4, 12, 20, or 28 extra contact channels (8,16, 24, or 32 respectively, total).

e)1, 4, 8, or 16 analog channels. f)Thermostatically controlled heater. g)Computer communications interface. h)Radio communications interface.

Specifications subject to change without notice.

SECTION 1. PRODUCT DESCRIPTION AND SUMMARY OF THIS MANUAL

PRODUCT DESCRIPTION

The VERBATIM® Voice Recording Autodialer functions as a remote alarm monitor, typically monitoring critical facilities which are not staffed 24 hours a day.

The VERBATIM® autodialer monitors 4 inputs (8, 16, 24 or 32 input options are available) from user-supplied external sensors, such as float switches, limit switches, etc. These sensors are usually dry, isolated contacts which close or open to indicate the sensed condition.

When any of the external sensors indicate an alarm condition, or when AC power fails, the VERBATIM® autodialer accesses the standard phone line to which it is connected, dialing the appropriate phone numbers and delivering the user's own prerecorded voice message corresponding to those particular alarm conditions that are currently active. Dialing continues repeatedly through the entire list of up to 16 programmed phone numbers, until the alarm is acknowledged by touch tone command or by calling the VERBATIM® autodialer back.

The user may also call the VERBATIM autodialer at any time from any telephone, to hear a complete voice report of current conditions.

The VERBATIM autodialer incorporates many flexible, voice-supported programming and message recording options, to meet a wide range of user requirements. Yet, in most cases the user may rely on pre-existing default programmed parameters, greatly simplifying programming. Even default voice alarm messages are provided.

ALL USER PROGRAMMING AND VOICE MESSAGE RECORDING MAY BE ENTERED, REVIEWED OR CHANGED EITHER FROM THE FRONT PANEL OR FROM

A REMOTE TELEPHONE AT ANY TIME. THUS, INSTALLATION AND PROGRAMMING MAY EASILY BE DONE BY SEPARATE PERSONNEL AT SEPARATE TIMES. Most programming is entered in the form of 3-digit codes as described herein. All user programming, including recorded messages, is maintained in permanent non-volatile memory.

Individual standard contact inputs may be optionally programmed to report status only or to accumulate run times, or even to totalize pulses from flow-meters, etc.. In most cases, the outputs of logic controllers may be connected directly to standard contact inputs without need for interfacing relays.

The VERBATIM autodialer incorporates extremely thorough and effective electrical surge protection and overall rugged construction, to deliver reliable operation under real-world conditions.

SUMMARY OF THIS MANUAL

This manual guides you through the following procedures:

LOCATION AND MOUNTING
INITIAL PROGRAMMING
VOICE MESSAGE RECORDING
USING YOUR PROGRAMMED VERBATIM
AUTODIALER
ADVANCED PROGRAMMING

A glossary explaining the terms used herein is included the end of the manual, along with a troubleshooting guide, an index, and FCC notice to users. Worksheets are provided to document and clarify your programming and message recording steps.

Please take a moment to read, complete, and mail the warranty card at the front of this manual.

SECTION 2. INSTALLATION

STEP 1: LOCATION AND MOUNTING

Choose a mounting location which is not exposed to condensing humidity or temperatures beyond the limits of 20°-130°F. This location should ideally be within 5 feet of a standard RJ-11 phone jack and a GROUNDED 120 VAC power outlet.

Mount the dialer on centers of $6" \times 11 \ 3/8"$ using the external mounting ears on the enclosure. #10 or 3/16" bolt sizes are best.

An optional NEMA 4X weatherproof outer enclosure is available. This allows the dialer to be mounted outdoors as long as temperature limits are not violated. It is best to provide at least an overhead shelter to minimize direct precipitation and solar heating effects.

An optional heater/thermostat is also available for cold or humid environments. The 120 vac heater-dissipates 75 watts, providing a temperature rise of approximately 30 degrees, or 60 degrees when enclosed in the optional NEMA 4X enclosure.

STEP 2: WIRING (Refer to the diagram)

Inspect and remove any foreign materials which might create short circuits.

Connect the red (positive) battery lead to the positive terminal on the gel-cell battery.

Plug the power cord into a GROUNDED 120 VAC OUTLET. Or, remove the power cord from the dialer and install well-grounded 120 VAC power to terminal strip TS3, located on the lower right of the main circuit board. If there are any green grounding wires in place on TS3 originating from plug-in expansion cards, leave those green grounding wires in place on the terminal marked GREEN. If the dialer turns on when power is applied, turn It off with the red ON/OFF key.

Connect dry (unpowered) contacts to the terminal strip connection points. The connection point for basic four-channel units is terminal strip TS1, located

on the lower left of the main circuit board. Note that there are four common return terminals marked "C"; any combination of these internally grounded terminals may be used. IS1 is unplugable for convenience. All terminal points are screw clamp type, eliminating the need for wire termination lugs.

The contact input wires should ideally be light (18 to 24 gauge) signal wire rather than heavy power wire. This reduces problems of bulk and stiffness.

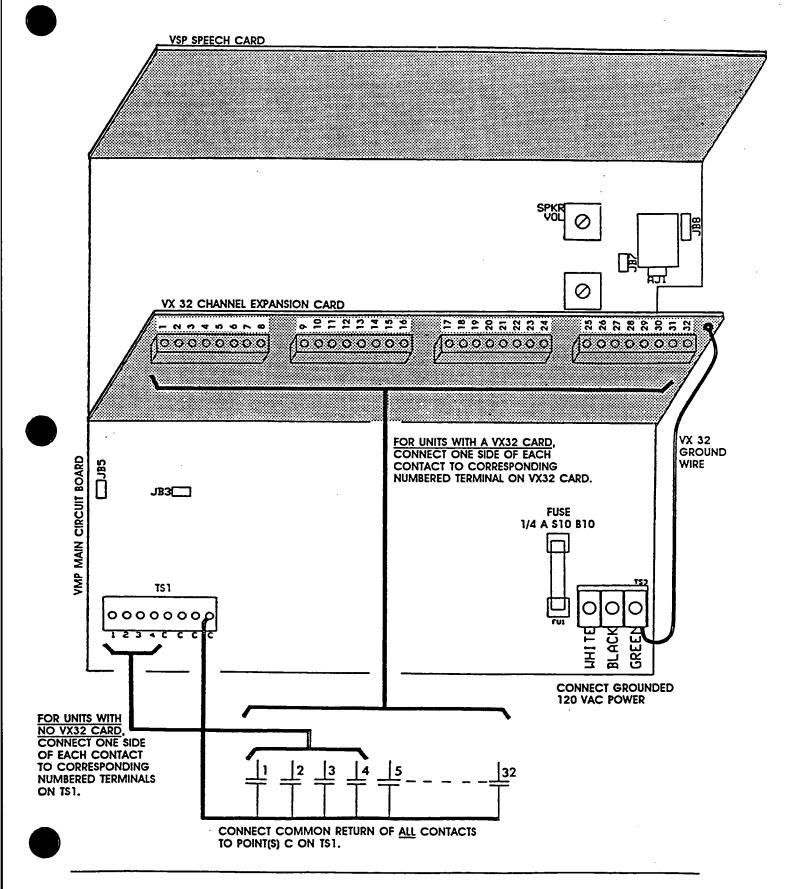
Units with 8 or more inputs have a VX32 Channel Expansion Card plugged into connector J4. If your unit has this card installed, then use TS1 for common return connections only, and connect one side of each contact to the appropriately marked channel input number on the VX32 card. Leave TS1 terminals 1,2,3 and 4 unconnected. Note that the common "return" side of the contacts will need to be consolidated into not more than four wires coming into the TS1 terminals marked "C". ROUTE THE WIRES TO THE VX32 CARD SO THAT THEY DO NOT PROTRUDE ABOVE THE TOP OF THE CARD, otherwise they will interfere with the front panel board when the door is closed.

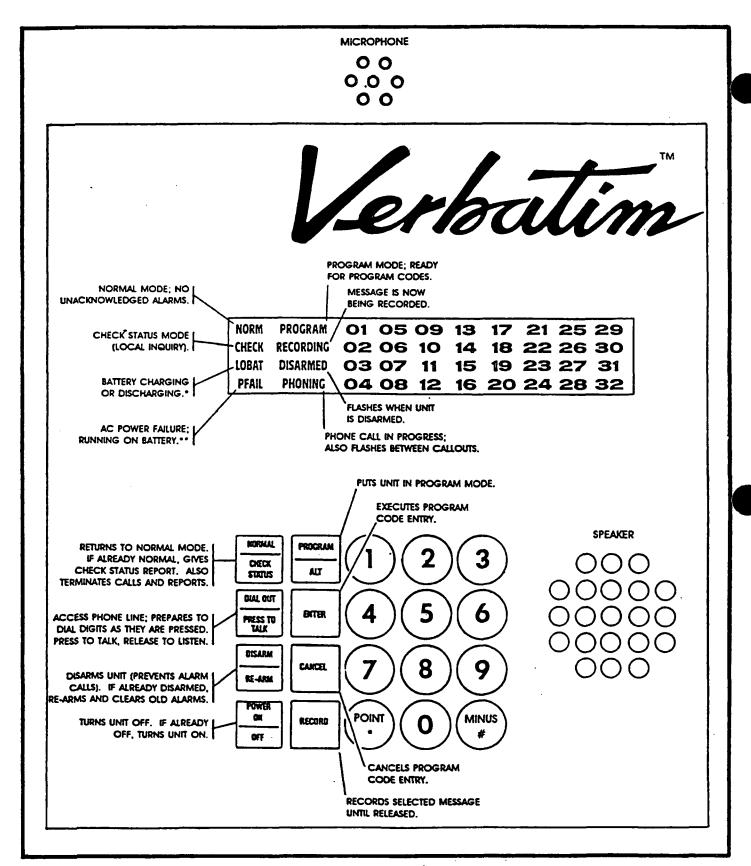
IN ALL CASES, BE SURE THAT THE CONTACT INPUTS ARE "DRY" AND DO NOT PROVIDE POWER OF THEIR OWN, OR THE DIALER WILL BE DAMAGED!

Note that terminal strip TS1, and the terminal strips on the VX32 card if any, are unpluggable. Be sure that wire stresses do not result in a terminal strip becoming unplugged when the door is closed, etc.

SPECIAL CASE:

If your inputs are coming from a logic controller with TIL, CMOS or 5-volt DC logic outputs, direct connection may be made as long as the controller has the same electrical ground as the dialer. If higher-voltage DC levels exist, use diodes in series with the dialer inputs, with the cathode (banded end) toward the source. In all cases, a low (0) logic level will be interpreted by the dialer as a closed circuit input.





- * With a fully charged battery, light should go out within a few minutes of turning on. A discharged battery may take up to a day to fully recharge.
- ** During AC power failure, all illuminated LEDs will flash to conserve battery power.

SECTION 3. INITIAL BASIC PROGRAMMING AND TESTING

3.1 STEP 1: RESETTING (CLEARING) THE UNIT

First press PROGRAM. This puts the dialer in the Program Mode, as indicated by the lighted program legend. All programming operations must be done with the unit in the Program Mode.

<u>CAUTION: The following step erases all user programming including recorded messages</u> so normally it is done only at initial startup.

To clear the system memory, press: 9 3 5 9 ENTER

If you make an error in code entry, press CANCEL and start again.

3.2 STEP 2: PROGRAMMING PHONE NUMBERS

Refer to PROGRAMMING WORKSHEET A. You are encouraged to write down the phone numbers you want to program, along with a person's name for each phone number.

To program the first dial-out phone number, press: 7 01 (then the complete phone number) ENTER

For example, to program 1 (415) 658-6713 as the first phone number, press:

701 1 415 658 6713 ENTER

To program a second phone number, use code 7 02 instead of 7 01, progressing to a maximum of code 7 16 for the 16th phone number.

Each number may be up to 24 digits in length. Be sure to include any necessary area codes or "1" prefixes.

SPECIAL CASES:

If you need touch tone dialing, press:
9 01 1 ENTER

하나 가는 그 이 경기를 가는 가는 가는 다니다.

To go back to standard pulse dialing, press: 9 01 0 ENTER

To insert delays between dialed digits, press the MINUS key once for each one second delay desired in the phone number programming process.

Refer to SECTION 6. ADVANCED PROGRAMMING, for specialized programming such as "grouping" phone numbers with input channels, or to establish and use a "call forward" phone number, etc.

3.3 STEP 3: PROGRAMMING INPUT CHANNELS

Your verbatim autodialer needs to know whether its input channels are to be NORMALLY CLOSED (alarm on Open Circuit), or NORMALLY OPEN (alarm on closed circuit).

All contact inputs are initially set normally closed (i.e. they will alarm on Open Circuit). This is the default setting and, therefore, any Open Circuits, including any inputs left unconnected during installation, will appear as alarms until the inputs are programmed.

To automatically program the inputs, first make sure all inputs are in their NORMAL (non-alarm) state. Then press:

500 ENTER

The VERBATIM autodialer automatically examines all inputs and programs them to <u>alarm on the opposite input state</u> from their present status. This code 500 does not affect any channels that have been programmed for status only, Run Time Meter, or Pulse Totalizer function.

SPECIAL CASES:

In most cases, no further programming of contact inputs is necessary. However, the following configuration options are available:

To set an <u>individual</u> contact input for normally closed operation (i.e. to alarm on open circuit), press:

5 ZZ 1 ENTER

where ZZ is the 2-digit channel number you are programming. Be sure to always use a leading 0 for channels 1 through 9 to keep the channel number a two-digit entry.

To set an <u>individual</u> contact input channel for normally open operation (i.e. to alarm on closed circuit), press:

5 ZZ 2 ENTER

Do you want any of your inputs set to report status only, never causing an alarm dialout? If so, program each individual channel as follows:

5 ZŽ 3 ENTER

Do you want any of your contact inputs set for the run-time meter function, never causing an alarm dialout but reporting the total accumulated hours that the input contact is closed? If so, program each channel as follows:

5 ZZ 4 ENTER (See SECTION 6.2.)

Do you want any of your contact inputs set for the Pulse Totalizer function? If so, refer to SECTION 6.2.

3.4 INITIAL TESTING

First, temporarily disarm the unit by pressing DISARM/RE-ARM until the DISARM LED is flashing. This prevents the unit from dialing out.

Next, physically trip each sensing device in turn (manipulate float switches, relays, etc.) and verify that the corresponding input channel LED lights at the front panel, and then restore all sensors to their normal state. Now press DISARM/RE-ARM. This will clear out the channel input LEDs and restore the unit to a ready condition.

Finally, to test the phone line connection, with the unit's phone cord plugged into its phone jack, temporarily remove the AC power cord to the unit. The PFAIL LED will illuminate. At this point all illuminated LEDs will flash on and off in order to conserve battery power. Since the unit is not disarmed this time, after a 0.1 minute Alarm Trip Delay the PHONING light will illuminate and the unit will access the phone line and begin dialing.

You should hear the ringing sound and perhaps the sound of someone answering the phone. The unit

will recite its station ID and power failure messages. You may converse with the person answering by pressing and releasing DIALOUT/PRESS TO TALK. Press this key again when you wish to speak, and release this key to listen. This action will suspend message recital. In this case, when the conversation is done, you should end the call by pressing NORMAL. Ordinarily the alarm call would end automatically.

Now press DISARM/RE-ARM twice. This step disarms and then rearms the unit clearing all acknowleged alarms. This clearing also occurs automatically after the Alarm Reset Time has elapsed (default value 1 hour. See SECTION 5.6).

Your VERBATIM autodialer is now able to operate, having at least one dialout phone number programmed and having its input channels configured. However, you may wish to record your own voice messages (see the next section) or perform special advanced programming items (see SECTION 6) before referring to SECTION 5 on USING YOUR PROGRAMMED VERBATIM AUTODIALER.

SECTION 4. RECORDING MESSAGES IN YOUR OWN VOICE

Be sure to complete the programming of the input channels as described in the previous section before recording any messages.

Recording messages is an optional step. Your VERBATIM autodialer comes with built-in default normal and alarm messages for all channels, so recording messages in your own voice can be postponed if you so desire, until you have become more familiar with your unit. You may even choose to record or re-record your own messages from a remote telephone at any time.

Ordinary contact Input channel default messages are "Channel N Normal" and "Channel N Alarm".

For "Status Only" and Run Time Meter programmed channels (never causing an alarm), the default messages are "Channel N is ON" when the input circuit is closed, and "Channel N is OFF" when the input circuit is open.

The default Station ID message is "ID Numer One." The ID message is included in every phone call to identify the calling unit.

SPECIAL CASES:

Are any of your input channels programmed for status-only reporting or for run-time metering? (See SECTION 6.) If so, and if you wish to record your own messages for these specially configured channels rather than relying on the default "Channel N is on" or "Channel N is off" messages, plan a message for the Closed Circuit condition and another message for the Open Circuit condition for each channel. For Run Time channels the unit will add a report of the run time in hours, using built-in speech, at the end of the appropriate closed or open circuit message.

Are any of your Input channels programmed for Pulse Totalizer function? If so, see SECTION 6.2 for special guidance in message planning and recording.

4.1 STEP 1: PLAN AND WRITE DOWN ALL YOUR MESSAGES

WORKSHEET C is provided to assist you with this. Please use the worksheet! Not only will you then have a written record of your messages for future

reference, you will also then be prepared to record your messages with the greatest ease and efficiency.

In addition to the overall Station ID message, two different messages are used for each contact input channel: one message for the NORMAL CONDITION and another for the ALARM (fault) CONDITION. Many users can leave the existing default "Channel N is Normal" message in place rather than devoting recording time to the Normal Condition message for each channel. This leaves more recording time available for recording ALARM (fault) CONDITION messages for each channel.

When you have written down the messages that you want to record, you are ready for:

4.2 STEP 2: VERIFYING/EXTENDING THE TOTAL AVAILABLE RECORDING TIME

Do you need to extend the available recording time? Unless you have installed extra speech memory, the available recording time is:

"Initial" total recording		Extendable to:		
time (at Rate	<u>); </u>	(Rate 2, 3 or 4)		
4 chan. unit	14 sec	21, 28 or 40 sec		
8 chan. unit	28 sec	42, 56 or 80 sec		
16 or more	56 sec	84, 112 or 160 sec		

Initially, the unit is set for the fastest memory use rate ("Rate 1"), giving the highest fidelity sound recording. If you are sure that your messages take less than the "initial" time shown above for your unit (14 seconds total for a 4-channel unit), go on to step 3. You may also verify your unit's current rate setting and corresponding total message recording time by pressing 9 1 1 ENTER.

If you need more time, or if you are not certain, the Verbatim autodialer's exclusive AutoextendTM feature will automatically extend the available recording time, selecting the optimum recording rate (speech memory rate) to give you the highest possible recording sound quality for your length of recording.

WARNING: The following step will erase any existing recorded messages.

To use the Autoextend $^{\text{TM}}$ feature to extend recording time, have your message worksheet

handy as you press: 9 1 2 ENTER

The VERBATIM autodialer will prompt you to immediately begin reciting your entire list of messages at the sound of the beep, one after another, at the same speed that you will want to later record them.

During this time, the VERBATIM autodialer will <u>not</u> be recording your spoken messages. Instead, it will be timing you.

When you have finished reciting (<u>not recording</u>) the last message, <u>Immediately</u> press ENTER.

Over the phone, press ZERO to start the timing, and ZERO again to end the timing. See SECTION 5.7, REMOTE OVER-THE-PHONE PROGRAMMING.

Based on how long your message recital took, the Autoextend feature will automatically calculate which recording rate is optimum for your length of recording time, and will then automatically select that rate. It will tell you how many seconds your message took, and how much total recording time it has now given you. Now you are ready for:

4.3 STEP 3: ACTUALLY RECORDING YOUR MESSAGES.

First, minimize any background sounds. Have your message worksheet in front of you and be prepared to recite the first ALARM (FAULT) CONDITION message in a loud clear voice within about 6 to 12 inches of the microphone located at the top of the front panel. Press:

1 ZZ ENTER

where ZZ is the appropriate 2-digit channel number, such as 01 for channel 1. Be sure to use leading zeroes, in order to keep ZZ a 2-digit entry. Use 00 for the Station ID message.

The voice specifically identifies the message you are about to record, and then prompts you to press the record key and hold it just for the duration of your spoken message. Note that the RECORDING light comes on during recording.

Over the phone, since there is no RECORD key, the voice will prompt you to press ZERO to begin recording, and press ZERO again to stop recording. (See SECTION 5.7.)

The VERBATIM autodialer will immediately play back the message you have just recorded, allowing you to determine if you need to re-record

it louder, softer or more clearly, etc. Experiment with different loudnesses to get the best message clarity. If there is too much background noise at the dialer site, record your messages over the phone.

Always stop the recording promptly to avoid wasting recording time.

To record an alternate "normal condition" message for channel ZZ, press:

2 ZZ ENTER and follow the same procedure as above.

To review an existing message for channel ZZ, press:

3 ZZ ENTER

The VERBATIM autodialer will replay both existing messages for channel ZZ. This will include any default messages remaining in use.

SPECIAL CASES:

For any channels that you have programmed for "Status Only" or for Run Time Meter function, use code 1 ZZ for the Open Circuit message, and 2 ZZ for the Closed Circuit message.

If you run out of recording time, you will hear the message "No more message time". Go back to STEP 2 above to re-establish total available recording time. You may elect to shorten some messages, or rely more on selected default messages, or you may AUTOEXTEND the available recording time. Then, rerecord all messages.

If you wish to extend the available time for a specific message while leaving the other messages unaffected, enter the code for recording that message, but add an extra digit 1 through 4, before pressing ENTER. The digit 1 (Rate 1) gives the shortest time and the best sound quality, while 4 (Rate 4) gives the longest time with poorest sound quality.

If you wish to reinstate a default message, enter the code for recording that message, and an extra POINT before pressing ENTER. For example:

1 ZZ POINT ENTER

If you wish to use the default Station ID message but with a different ID number in place of the "one" press:

one, press:
9 1 4 N ENTER
where N is the desired ID number which may be up
to 24 digits long. Some users program the VERBATIM
autodialer's own phone number as its ID number.

If you want to set a specific recording rate rather than letting Autoextend do It, press:
9 1 3 N ENTER

where N is the desired recording rate 1, 2, 3 or 4.

You will then need to re-record any messages that were previously recorded at a different rate.

SECTION 5. USING YOUR PROGRAMMED VERBATIM AUTODIALER

5.1 PLACING INQUIRY CALLS TO THE VERBATIM AUTODIALER

You may call the VERBATIM autodialer any time from any phone. After the programmed number of rings (default 1 ring), the VERBATIM autodialer will answer, first giving its Station ID Message, then any special warning messages (such as not having any phone numbers programmed, unit is in the disammed state, etc.), and then the status of each channel input. If there are no unacknowledged or acknowledged alarm conditions on any channel, then just before the status report the VERBATIM autodialer will say "All channels normal". If this call is acknowledging an unacknowledged alarm, the VERBATIM autodialer will say "Alarm is acknowledged".

The channel status report will be recited 3 times. Between each recital the VERBATIM autodialer will issue a prompting beep and then wait a few seconds for you to optionally enter a special Command Tone (see SECTION 5.7 below on over-the-phone programming). If you have not chosen to enter a tone, the unit will say "Goodbye" and terminate the call.

5.2 "CHECK STATUS" INQUIRY AT PANEL

When the NORM LED is lit, you may hear a report of current conditions by pressing the NORM/CHECK STATUS key. You may cut this report short by again pressing the NORM/CHECK STATUS key.

5.3 RECEIVING ALARM CALLS FROM THE VERBATIM AUTODIALER

When any input condition violates the alarm condition programming, and if that violation persists for the duration of the Alarm Trip Delay for that input, the unit goes into an Unacknowledged Alarm state and begins dialing the first of up to 16 programmed phone numbers. (See SECTION 6.1 on optional Alarm Call Grouping If you want the numbers dialed to depend on which channel is in alarm.) The corresponding channel alarm LED begins flashing to indicate an unacknowledged alarm.

After dialing the first number, the VERBATIM autodialer waits a few seconds and then begins speaking its messages. The messages follow the same format as for an inquiry call, including the prompting beep, except that channels that have no alarm activity are not included in the alarm report. If there is no acknowledgement, the VERBATIM autodialer will repeat the message for the programmed number of repeats (default 3 repeats), then will say "Goodbye" and terminate the call.

If the alarm violation is corrected after the unit has gone into an Unacknowledged Alarm state, <u>calling will not cease</u>. However, the phrase "now normal" will be added at the end of each recital of the Alarm Condition message. Exception: For power failure alarms, when power is restored the message is "Power is on."

If the alarm has been acknowledged, the word "acknowledged" will be added.

These alarm messages will then continue to be included in any status reports until the Alarm Reset time expires.

If a channel is in violation but its Alarm Trip Delay has not timed out, the channel's alarm message will be recited, with the word "alert" added.

5.4 CONTINUED DIALING IN THE ABSENCE OF ACKNOWLEDGEMENT

The VERBATIM autodialer will then wait for the programmed Time Between Alarm Calls (default 2 minutes), during which you may call the VERBATIM autodialer back to acknowledge the alarm. If no acknowledgement is received at the end of this period, the next phone number will be dialed. The process will be repeated indefinitely, repeatedly going through all the designated phone numbers, until acknowledgement is received.

5.5 ACKNOWLEDGING THE ALARM CALL

To acknowledge the alarm during the alarm call, enter a touch tone "9" at the sound of the prompting beep. The VERBATIM autodialer will say "Alarm is acknowledged, Goodbye" and terminate the call. See SECTION 5.7 for additional ways of acknowledging an alarm without ending the call.

An alternate way to acknowledge the alarm is to wait for the alarm call to end, then call the VERBATIM autodialer back. At the front panel, pressing NORMAL, PROGRAM, DISARM, or DIALOUT will also acknowledge the alarm. Upon acknowledgement, the channel LED changes from flashing to steady illumination.

5.6 ALARM RESET TIMEOUT AFTER ACKNOWLEDGEMENT

Upon receiving an acknowledgement, the VERBATIM autodialer begins timing out the Alarm Reset Time, (default 1 hour). Further calling on behalf of that channel is suspended, regardless of further activity at that particular input during this period. If new alarms occur on other channels during this period, the unit will go back into the Unacknowledged Alarm state and dial the first appropriate phone number, with dialing continuing until a new acknowledgement is received.

At the end of the Alarm Reset period the channel alarm LED turns off, the Acknowledged Alarm status is cleared for that particular channel input, and it is again ready to go into Unacknowledged Alarm whenever a violation occurs at that input. In particular, this means that if the violation had not been removed prior to the timeout, dialing will begin again immediately upon timeout of that Alarm Reset period.

It may be helpful to refer to the diagram "Anatomy of an Alarm."

5.7 REMOTE OVER-THE-PHONE PROGRAMMING

During any phone call (inquiry call or alarm call), at the end of each round of messages, the prompting beep is issued. If you press a Command Tone "1" at the sound of the beep, the VERBATIM autodialer will prompt you to enter a program code. (Or, if you have established a Security Access Code, you will first be prompted for this code). You may enter codes for most of the programming operations described in this manual except reading or changing the optional security access code.

Since some of the front panel keys are not found on a touch tone keypad, some special conventions apply for over-the-phone programming:

In Place Of:	Enter:
CANCEL	* *
ENTER	##
POINT	*
MINUS	#

To end a phone call after programming, press # # without a prior digit entry. The VERBATIM auto-dialer will then issue a prompting beep which is an opportunity to re-enter a "1" if you didn't want to end the call. It will then say "Goodbye" and end the call.

Special exception: over the phone, you may not program more than one consecutive dialing delay, because # # (two in a row) is interpreted as ENTER when programming over the phone. However, you may extend this delay using code 928; see PRO-GRAM CODE table.

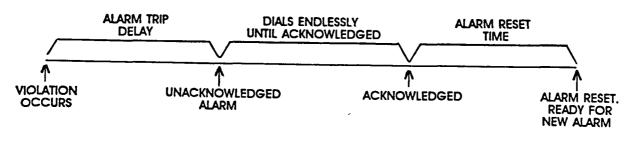
If you initially enter a Command Tone "2" in place of the "1", you will be in a special Program Review Mode, which allows you the safety of checking any of the programming items or messages, without the possibility of altering any of them.

If you initially enter a Command Tone "3" in place of the "1", you will hear a report of each channel that has any acknowledged or unacknowledged alarm condition.

If you initially enter a Command Tone "4" in place of the "1", you will hear a listing of all programmed phone numbers, plus any other basic programming items that you have altered from their default values. This is particularly useful in diagnosing operating problems.

If you initially enter a Command Tone "0" in place of the "1", the unit will immediately say "goodbye" and end the phone call.

Note that if there is an unacknowledged alarm, entering any of these tones will also acknowledge



ANATOMY OF AN ALARM

the alarm, in addition to their other primary functions.

5.8 USING THE VERBATIM AUTODIALER TO DIAL OUT AND CONVERSE (SPEAKERPHONE)

At the panel, starting in the Normal Mode, press the DIALOUT/PRESS TO TALK key. Next press the digits of the phone number you want to dial. Each digit you press will be dialed as you press it. You will then hear the sound of the ringing. When you hear the phone answered, press and hold the same DIALOUT/PRESS TO TALK key as you speak to the person on the line, and release the key to listen. Continue the conversation in this manner. To end the call press NORMAL. If the DIALOUT/PRESS TO TALK key remains unpressed for more than 2 minutes, the VERBATIM autodialer will automatically end the call.

To automatically re-dial a number that was previously manually entered by this method, press DIALOUT/ PRESS TO TALK as before, then press ENTER rather than entering digits manually.

If you are at the panel when a phone call is in progress, you may suspend the message report and converse with the person on the other end by pressing the DIALOUT/PRESS TO TALK key as described above. There will be no additional dialing, since connection has already been established. To end the call, press NORMAL.

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SECTION 6. ADVANCED PROGRAMMING

6.1 COMPLETE LIST OF ALL PROGRAM CODES

The following table summarizes the wide variety of available programming operations, along with a description and comments. Additional information may be found in referenced notes below as well as in the referenced sections elsewhere in the manual.

When the overall programming is cleared out at initial startup, all programming is automatically set to factory default values as shown in the table. Most of these default values are quite suitable for most users and only selected items may need to be programmed to different values.

In general, entering a code and then ENTER without any intervening value reads the existing programmed setting without changing it. Also, in general, entering POINT after the code and before ENTER will clear program item, or will return it to its default value.

In this table several forms of numeric value entries are shown. They are:

- V A value of one or more digits which may include a decimal point. Examples: .5, 2.8, 300.6, 60.
- N One more digits giving a whole number; no decimal points allowed. Examples: 1, 5, 20.
- DN A two-digit Designation Number for phone numbers (01 for first number, 02 for second, etc.).
- 1/0 Used to turn a function ON (1) or OFF (0).
- ZZ 2-digit channel number (use ZZ=00 for ID message).

NOTES FOR PROGRAMMING CODE TABLE:

- 1. ZZ = 2 digit channel number. Use ZZ = 00 for Station ID message.
- For any channels you have programmed as "Status Only" or "Run Time Meter", use code 1 ZZ for the Open Circuit message, use code 2 ZZ for the Closed Circuit Message. See SECTION 6.2 for message information for any Pulse Totalizer channels.
- 3. DN (Designation Number) is 01 for first dialout phone number, 02 for second number, etc. DN = 00 for special "callback" phone number. Use MINUS to insert any needed delays between digits. Each such delay is 1 second unless extended using code 928.
- 4. Actual power failure trip delay may be a fraction of a second longer than programmed value, due to power supply discharge time.
- 5. CAUTION: If Alarm Reset Function is turned OFF, acknowledged alarms will NEVER SELF CLEAR, preventing further alarm calls after acknowledgement for each channel.
- 6. Speaker always operates during front panel operations, even if turned off.
- 7. Cannot be read or changed over the phone.
- 8. Does not change channels that have been configured for "Status Only," "Run Time Meter," or "Pulse Totalizer."
- 9. CAUTION: High Speed Dialing setting may not work reliably with some telephone company exchanges.
- 10. Add POINT to restore default message.
- 11. To pre-set a Run Time value, Include the value before ENTER.
- 12. Maximum value that can be entered is 4,294,967,294.

	4
•	•

4. -

CODE	DESCRIPTION AND COMMENTS	DEFAULT	RANGE	NOTE	SECTION
	CHANNEL STATUS READING			T	I
DZZ	Read status of channel ZZ				6.2
DZZO	Read actual open/closed ciruit status directly		 		6.2
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	MESSAGE RECORDING AND REVIEWING				
100	Record Station ID Message		1	1, 2, 10	4.3, 6.2
IZZ	Record channel ZZ ALARM message		\ <u></u>	1, 2, 10	
272	Record channel ZZ NORMAL message		 		4.3, 6.2
322	Review channel ZZ both messages (ZZ=00 for Station ID msg.)			1	4.3, 6.2
	Also see 911, 912, 913, 914 and SECTION 4 on messages				
	CHANNEL PROGRAMMING (CONFIGURATION)		1		
500	Sets current status as NORMAL for all channels	Norm Closed	1		3.3, 6.2
ZZ	Reads alarm criteria for chan ZZ	Norm Open		1	6.2
ZZ 1	Sets chan ZZ Normally Closed		1	1	3.3, 6.2
ZZ 2	Sets chan ZZ Normally Open			1	3.3, 6.2
SZZ 3	Sets chan ZZ for No Alarm (status report only)		<u> </u>	11	3.3, 6.2
ZZ 4	Sets chan ZZ for Run Time Meter Operation			1, 11	3.3, 6.2
ZZ 6 N	Pulse Totalizer: set alarm setpoint N		Note 12		6.2
2Z 7 N	Pulse Totalizer: activate with starting value N (note 2)		Note 12		6.2
ZZ 8 N	Pulse Totalizer: set scale factor N		Note 12		6.2
	ALARM CALL GROUPING				
5ZZ 9	Reads chan ZZ Alarm Call Grouping linkage			1	6.2
ZZ 9 DN	Links chan ZZ to phone numbers DN			1	6.2
ZZ 9 POINT	Clears channel ZZ linkage			1	6.2
	ALARM TRIP DELAYS				
00	Reads Power Failure Alarm Trip Delay	0.1 min			6.2
00 V	Sets Power Fallure Alarm Trip Delay to V		1		6.2
SZZ	Reads chan ZZ Alarm Trip Delay	2 sec	.1-999.9	1	6.2
SZZ V	Sets chan ZZ Individual Alarm Trip Delay to V			1	6.2
ZZ POINT	Returns chan ZZ Individual Alarm Trip Delay to 2 sec]1	6.2
02 V	Sets Global (all channels) Alarm Trip Delay to V	2 sec.	.1-999.9		6.2
	PHONE NUMBERS and PULSE/TONE DIALING			•	
DN	Reads phone number DN (DN = 01 through 16)				3.2, 6.2
DN N	Sets phone number DN to N (phone # up to 24 digits)			3	3.2, 6.2
ON POINT	Clears out phone number DN				3.2, 6.2
28 N	Extends length of Inserted dialing delays to N seconds	Lsec. 4 sec.	1-10		3.2, 5.7, 62

5e f	40	•

tone		
15	_	_
6	_	_

	MISCELLANEOUS PROGRAMMING ITEMS			1	
901 0/1/2	0=Pulse Dialing; 1=Tone Dialing; 2=High Speed Dialing	Pulse tone		9	6.2
902 V	Sets Global (all channels) Alarm Trip Delay to V	2 sec.	.1-999.9		6.2
903 V	Sets Time Between Callouts to V	2 min. 15 min	.1-99.9		6.2
904 V	Sets Alarm Reset Time to V	Lhour 6 hr	.1-99.9		5.6, 6.2
905	Clears all acknowledged alarms; clears reset timers				6.2
906 N	Sets Ring Answer Delay to N (must be a whole number)	1 ring	1-20		5.1, 6.2
907 N	Sets number of Message Repeats to N (whole number)	3	1-20	T	5.3, 6.2
908 1/0	1 turns Autocall ON; 0 turns OFF	OFF			6.2
909 V	Sets Autocali Interval to V	24 hrs.	.1-99.9		6.2
910 N	Establishes a Security Access Code N (up to 8 digits)	None		7	6.2
911	Reads current recording rate and avail. recording time				4.2
912	Autoextend: sets optimum rec rate for recited messages				4.2
913 N	Sets Recording Rate	Rate 1	1-4		4.2
914 N	Inserts N in place of 1 in canned Station ID message	1			4.3
920 V	Power Failure Trip Delay (duplicates function of code 600)	0.1 min.	.1-999.9	4	6.2
921 1/0	1 turns Power Failure Alarm ON; 0 turns OFF	ON		1	6.2
922 1/0	1 turns Alarm Reset timers ON; 0 turns OFF	ON		5	6.2
924	Initiates test caliback to phone # 00				6.2
926 V	Sets Delay Before Return to Normal (Exit Delay) to V	2 min.	1-99.9		6.2
928 N	Extends length of inserted dialing delays to N seconds	1 sec.	1-10		3.2, 5.7, 6.2
930 1/0	1 Arms unit for alarm callouts; 0 disarms	ARMED			6.2
932	Invokes one-time 15 second listening period		1		6.2
933 1/0	1 turns local Microphone ON; 0 turns OFF	OFF			6.2
934 1/0	1 turns Speaker ON; 0 turns OFF	ON		6	6.2
	CLEAROUT OPERATIONS				
935 0	Clears out phone numbers; sets all delays to default			T	6.2
935 1	Clears out phone numbers only				6.2
935 2	Clears out all Alarm Call Grouping linkage				6.2
935 3	Sets all delays to default values				6.2
935 4	Clears all user recorded messages				6.2
935 5	Clears all programming except messages				6.2
935 6	Clears all totalizers to 0 (not to preset) reading				6.2
935 9	Total clearout: ERASES ALL PROGRAMMING & MESSAGES				3.1, 6.2
	DIAGNOSTIC READOUTS				
940	Reads all 4 diagnostic counts (add 0 to clear all 4)				6.2
940 1	Reads Call In Count (add 0 to clear)				6.2
940 2	Reads Dial Out Count (add 0 to clear)				6.2
940 3	Reads Acknowledged Alarm Count (add 0 to clear)				6.2
940 4	Reads Power Falloure Alarm Count (add 0 to clear)				6.2

6.2 COMPLETE DESCRIPTION OF ALL PROGRAMMING OPERATIONS

THE FOLLOWING DESCRIPTIONS SHOW THE RELEVANT PROGRAM CODES IN PARENTHESES, AND ARE ORGANIZED APPROXIMATELY ACCORDING TO THEIR APPEARANCE IN THE LIST OF PROGRAM CODES IN SECTION 6.1.

Refer also to section 5 for a description of over-thephone programming, etc.

CHANNEL STATUS READING

(0 ZZ) READ STATUS OF CHANNEL ZZ

Plays the message that corresponds to the present input condition of channel ZZ.

(0 ZZ 0) READ OPEN/CLOSED CIRCUIT STATUS DIRECTLY

Says "Channel ZZ is closed" if channel ZZ input is presently closed circuit, or "Channel ZZ is open" if the input is open circuit. Useful in troubleshooting, especially at setup time.

MESSAGE RECORDING AND REVIEWING

Be sure to refer to Section 4 for important details on message recording, including for codes 911, 912, 913, 914.

(100) RECORD STATION ID MESSAGE

(1 ZZ) RECORD CHANNEL ZZ ALARM MESSAGE

Also used for Open Circuit message for channels programmed for NO ALARM (status only), or for Run Time Meter operation. Also used for preamble message for channels programmed for Totalizer function.

(2 ZZ) RECORD CHANNEL ZZ NORMAL MESSAGE

Also used for Closed Circuit message for channels programmed for NO ALARM (Status Only) or for Run Time Meter operation. Also used for "units of measure" portion of message which follows preamble and digit readings, for channels programmed for Totalizer function.

(3 ZZ) REVIEW CHANNEL ZZ MESSAGES
(Use 3 00 to review Station ID message)

CHANNEL PROGRAMMING (CONFIGURING)
Also see SECTION 3.3.

(500) SET PRESENT INPUT STATUS AS NORMAL CONDITION FOR ALL CONTACT INPUT CHANNELS

Used at setup time, as the most expedient way of programming the Normally Open/Normally Closed

configurations ("Alarm Criteria") of contact input channels. Special configurations such as Status Only, Run Time Meter or Totalizer may then be progrummed for specific individual channels. This code does not affect channels already programmed for Status Only, Run Time Meter, or Pulse Totalizer.

(5 ZZ) READ CHANNEL ZZ PROGRAMMING ("ALARM CRITERIA")

(5 ZZ 1) SET CHANNEL ZZ FOR NORMALLY CLOSED OPERATION

An Open Circuit condition will cause an alarm.

(5 ZZ 2) SET CHANNEL ZZ FOR NORMALLY OPEN OPERATION

A Closed Circuit condition will cause an alarm.

(5 ZZ 3) SET CHANNEL ZZ FOR NO ALARM (STATUS ONLY)

(5 ZZ 4) RUN TIME METER PROGRAMMING

You may program any of the ordinary input channels to accumulate and report the number of hours that their respective input circuits have been closed. Any such channels will never cause an alarm, but on inquiry will recite the channel's closed circuit message or the open circuit message according to the status of the input, and will then report the accumulated closed circuit time (run time) to the tenth of an hour.

To program channel ZZ for Run Time Meter operation, Press:

5 ZZ 4 ENTER

To preset a starting value, press:

5 ZZ 4 V ENTER

where V may be any value from 0 to 99,999.9.

To delete the Run Time Meter programming, use one of the other 500 series codes to reprogram the channel for the desired programming operation.

As with channels programmed for NO ALARM (Status Only) operation, the default Open Circuit message is "Channel N is off." To record your own Open Circuit message for channel ZZ, use program code 1 ZZ. The default Closed Circuit message is "Channel N is on." To record your own Closed Circuit message for channel ZZ, use program code 2 ZZ.

(5 ZZ 6, 5 ZZ 7, 5 ZZ 8, 935 6) PULSE TOTALIZER FUNCTION PROGRAMMING

The Totalizer function counts the accumulated number of pulses (momentary contact closures) occur-

ring at the input for a channel which you have programmed for Totalizer operation. This function is typically used to accumulate the pulse output of rotary flowmeters. An alarm setpoint may be programmed to create an alarm call upon reaching a particular total value. Scale and offset factors are programmable, and user-recorded messages may be used.

Any contact input channel may be programmed for the Totalizer function, up to a total of 8 Totalizers. The input pulse rate must not exceed 100 pulses per second, and if the rate is over 50 pulses per second, the pulses must have a 50% duty cycle.

To program channel ZZ for totalizer operation, press: 5 ZZ 7 ENTER.

To establish a non-zero starting value for the spoken reading, add the desired starting spoken value after the 7 and before ENTER.

To establish a scale factor (so that a number of pulses will be translated into a single spoken unit count), press:

5 ZZ 8 N ENTER

where N is the number of pulses corresponding to a single spoken unit count. For example, if a pulse from a flowmeter occurs for each 1/10 gallon of water flow, but the desired report is desired in thousands of gallons, a value of 10,000 would be used for N. The unit uses the word "percent" in speaking of the scale factor.

The spoken scaled value will "roll over" to zero upon reaching 4,294,967,294. Values above this should not be entered at the keyboard.

The default message for Totalizer channels is "Channel N totalizer count is N." User-recorded messages are normally done in two segments. Use program code 1 ZZ to record a preamble message such as "The total water flow reading is". Use program code 2 ZZ to record an ending units-of-measure message such as "thousand gallons". During the report, the unit will insert the digits comprising the actual scaled value. In this example, the resulting complete report would be "The total water flow reading is (spoken value) thousand gallons".

To establish a Totalizer alarm setpoint, press: 5 ZZ 6 N ENTER.

When the scaled value reaches N, the unit will go into Unacknowledged Alarm and begin dialing. You may program a value of zero for N, to cancel any previously programmed Totalizer alarm setpoint for channel ZZ.

To clear out <u>all</u> totalizer readings to zero in one step, press:

935 6 ENTER.

(5 ZZ 9, 935 2) ALARM CALL GROUPING

This is a programming step that "links" selected channels to selected dialout phone numbers, so that when a given channel goes into alarm, only the phone numbers "linked" to that channel will be dialed. Ordinarily, an alarm on any channel will cause dialing of the entire list of phone numbers.

Alarm Call Grouping is typically done when certain channels are associated with a specific category of personnel, such as electrical, plumbing, security, etc. Note, however, that Power Failure to the dialer causes dialing of all phone numbers. If you need to limit Power Failure alarm calls to selected numbers, turn off the regular Power Failure alarm function using code 9 2 1 0, described below, and then connect an unused input channel for power failure monitoring, using the contacts of a relay.

To program for Alarm Call Grouping, it is important to first write in your entire list of phone numbers on PROGRAMMING WORKSHEET A. Note that there is a 2-digit "Designation Number" on the worksheet associated with each phone number (01 for the first number, etc.). Note the correspondence with the 3-digit program code for entering phone numbers (701 for the first number, etc.).

Next, fill in PROGRAMMING WORKSHEET B, referring to the filled-in examples for guidance. The right-hand column will now contain the actual program code strings which you should now enter, terminating each string entry with the ENTER key.

For example, to link channel 1 to the second and fifth phone numbers, following the filled-in example, you would press:

5 01 9 02 05 ENTER

Phone numbers will always be dialed in ascending order of the 2-digit Designation Numbers, regardless of their order in your program code entry. Note that an alarm on any channel that is not "linked" with a program code entry will cause dialing of the entire list of phone numbers.

To read the linkage programming on channel ZZ, press:

5 ZZ 9 ENTER

To "unlink" channel ZZ so that it again calls all phone numbers, press:

5 ZZ 9 POINT ENTER

To undo all existing linkage on all channels, press: 9 3 5 2 ENTER

(6 ZZ, 902,920,921) ALARM TRIP DELAYS

The Alarm Trip Delay is the length of time after a violation occurs before the unit goes into Unacknowledged Alarm and begins dialing. The default value is 2 seconds for all inputs and 0.1 minute for power failure. During this time, if a status is read, the message will be the ALARM message, with the extra word "alert" appended. If the violation is corrected before the Alarm Trip Delay times out, no alarm or dialout will occur.

There are two ways to change this Alarm Trip Delay: <u>global</u> (common for all channels except power failure) programming, and <u>individual</u> programming for each channel and power failure.

To program a new <u>alobal</u> Alarm Trip Delay, press: 9 0 2 V ENTER

where V is a value consisting of 1 to 4 digits, between .1 and 999.9 seconds. For example, possible entries include .1, 5, 5.1, and 600.1 (seconds).

If you wish to program a new <u>individual</u> Alarm Trip Delay for an individual ZZ channel, press:

6 ZZ V ENTER

To set a different Power Failure Trip Delay, press: 6 00 V ENTER (code 920 does the same thing)

To turn off the Power Failure Alarm function, press: 9 2 1 0 ENTER.

To turn the Power Failure Alarm function on again, press:

921 1 ENTER.

Note that the global code 902 overrides any previously set individual channel Alarm Trip Delays. Therefore, If you wish to establish a different global Alarm Delay and also program selected inputs for still different individual trip delays, perform the global programming first, and then any individual trip delay programming.

(7 DN, 901, 928) PHONE NUMBER PROGRAMMING Also see ALARM CALL GROUPING, above, and Section 3.2.

NOTE: DN is the 2-digit Designation Number: 01 for the first phone number, 02 for the second number, up to 16 for the 16th phone number.

Refer to PROGRAMMING WORKSHEET A. Write down each phone number you wish to program, along with a person's name, for future reference.

To program the first phone number to be dialed on alarm, press:

7 01 (then the complete phone number) ENTER.

To program the second phone number to be dialed on alarm, use code 7 02 in place of 7 01, progressing to a maximum of code 7 16 for a 16th phone number.

Each phone number may be up to 24 digits in length. Be sure to include any necessary area codes or "1" prefixes.

To erase phone number DN, press:

7 DN POINT ENTER.

If you need Touch Tone dialing, press:

901 1 ENTER.

For extra-high-speed dialing, press:

901 2 ENTER.

CAUTION: High speed dialing is for specialized applications may not work reliably with some telephone company exchanges.

To switch back to pulse dialing, press:

901 0 ENTER

To insert delays between dialed digits (e.g. after a leading "9" in PBX systems), in the programming process press the MINUS key once for each one-second delay desired. To extend the length of each delay beyond 1 second, press:

928 N ENTER

where N is the number of seconds of delay desired for each delay invoked with the MINUS key.

MISCELLANEOUS PROGRAMMING TIPS

(903) TIME BETWEEN ALARM CALLOUTS

This is the length of time after ending one alarm callout and before beginning the next callout.

Default value is 2 minutes; range is 0.1 to 99.9 minutes. To program a different number of minutes V, press:

903 V ENTER.

(904, 922) ALARM RESET TIME

This is the length of time after acknowledgement before a given channel (or Power Failure) is automatically reset to a clear condition, ready to act on a new alarm condition. Refer to the diagram "Anatomy of an Alarm" in SECTION 5 for a depiction of the various events involved in association with the Alarm Reset Time. Default value is 1 hour; range is 0.1 to 99.9 hours. To program a different number of hours V, press:

904 V ENTER.

To turn the Alarm Reset Timer function off, press: 9 2 2 0 ENTER.

CAUTION: YOU SHOULD NOT TURN THE ALARM RESET TIMER FUNCTION OFF under normal circumstances, because once a given channel's alarm has been acknowledged, it would never again cause an alarm callout.

To turn the Alarm Reset Timer function on again, press:

922 1 ENTER.

(905) CLEAR ALL ACKNOWLEDGED ALARMS AND ALARM RESET TIMERS

Especially during setup and testing, it is useful to be able to retrip an alarm after it has previously been tripped and acknowledged, without having to wait for the Alarm Reset Time to expire. To perform this clearout, press:

9 0 5 ENTER.

At the panel, the same result may be more easily obtained by pressing DISARM/RE-ARM to disarm the unit, then pressing it again to rearm the unit.

(906) RING ANSWER DELAY

This is the number of rings required when calling the unit, before the unit will answer. A long ring delay might be programmed if you wish personnel to have the opportunity to answer a regular telephone on the same line, before the dialer would answer. Default value is 1 ring; range is 1 to 20 rings. To program a different number of rings N, press:

906 N ENTER.

(907) NUMBER OF ALARM MESSAGE REPEATS

This is the total number of times each message or set of messages is spoken during each alarm callout. Normally a value of 3 repeats (strictly speaking, the alarm message plus 2 additional repeats) should be programmed, because some messages would not take long to speak and you need to allow adequate message recital time so that the person called will have adequate time to answer the phone call and hear at least one complete set of messages. Default value is 3 repeats; range is 1 to 20 repeats. To program a different number of repeats N, press:

907 N ENTER

(908) AUTOCALL TEST FUNCTION

The Autocall Test Function causes the unit to place test calls at regular intervals for the purpose of ongoing verification of dialer and phone line functioning. Calls are placed only once for each interval, to each regular phone number programmed (7 01 through 7 16), except that if anyone acknowledges a test call, no further calls will be placed for that time interval. Each call gives the station ID message and a statement that this is a test call, plus a report of all inputs.

To turn this function on, press: 9 0 8 1 ENTER

To turn it off, press: 9 0 8 0 ENTER.

The first series of calls begins as soon as the Autocall Test Function is turned on. Therefore, if you want the unit to call at 5 PM each day, you will need to turn this function on at that time. The default interval is 24 hours; range is 0.1 to 99.9 hours. To program a different interval V, press:

909 V ENTER.

(910) SECURITY ACCESS CODE

Once you establish a Security Access Code, unauthorized personnel are prevented from altering your programming or messages over the phone without first entering the Access Code. This does not affect programming access at the panel.

To establish an Access Code N of up to 8 digits, press:

9 1 0 N ENTER at the panel.

Once established, whenever you press a Command Tone 1 at the prompting beep, the unit first prompts you to enter the Access Code before allowing you to perform programming or message recording operations. You may still read existing programming without using the Access Code by pressing a Command Tone 2 at the prompting beep. However, the Access Code itself cannot be read over the phone.

To delete the Security Access Code so that no code required in order to perform over the phone programming, press:

9 1 0 POINT ENTER at the panel.
(921, 930) POWER FAILURE ALARM FUNCTION
ON/OFF; DISARM/RE-ARM ALL ALARMS

To turn off the Power Failure Alarm function, press:

921 0 ENTER.

To turn the Power Failure Alarm function on again, press:

921 1 ENTER.

To disarm the unit, preventing any alarm callouts, press:

930 1 ENTER.

To rearm the unit, press:

9302 ENTER.

At the front panel, the same result is more easily obtained by using the DISARM/RE-ARM key.

(700, 924) CALLBACK/CALL FORWARD

This feature causes the unit to dial a special "zeroth" phone number on command. This is typically initiated over the phone, causing the unit to call back to the person who invoked the command, in order to verify the ability of the unit to successfully dial out. The unit gives a status report of all channels as part of this call.

To program this special callback number, press:

7 00 (then the complete phone number)

To initiate the actual dialing, press:

9 2 4 ENTER

If you have executed this command over the phone, the unit will advise you that it will be calling the callback number in 15 seconds. Then it will end the current call in preparation for placing the callback call. If you have executed this command at the tront panel, the dialing will occur immediately.

(926) DELAY BEFORE RETURN TO NORMAL (EXIT DELAY)

Sometimes it is desirable to prepare the unit for the ability to detect violations and dial out, but with an "exit delay" that allows the user time to exit or remove temporarily existing alarm violations before the unit becomes active. To do this, press:

926 V ENTER

where V is the desired delay in minutes (range 0.1 to 99.9 minutes). Then press DISARM/RE-ARM if necessary to extinguish the flashing DISARMED legend light. However, do not press NORMAL, but instead leave the unit in PROGRAM mode, with the PROGRAM light illuminated. The unit cannot go into alarm while in PROGRAM mode. When the delay period times out, the unit will automatically return to NORMAL mode and will then be ready to act on any alarm violations that occur after that time. This code must be re-entered each time you wish an exit delay, since the delay value automatically returns to the default value of 2 minutes upon timeout. The 2 minute default value provides protection against the possibility that someone might walk away leaving the unit in PROGRAM mode, or perhaps hang up the phone after performing over-thephone programming without properly ending the call.

(932, 933, 934) MICROPHONE AND SPEAKER OPERATION

If you enable the front panel microphone using program code 933 as described below, the microphone will be automatically activated for a 15 second listening period at the end of each alarm or inquiry call, allowing you to hear the sounds near the unit from a remote telephone.

An additional prompting beep is issued at the end of this listening period, allowing you to postpone tone acknowledgement until after the listening period.

To turn this function on, press:

9 3 3 1 ENTER

To turn this function off, press:

933 0 ENTER

If you have turned the microphone on, as above, then during any phone call, you may also invoke a one-time listening period by entering Remote Program Mode (press 1 at the prompting beep) and then entering 9 3 2 # #.

To turn off the speaker so that neither alarm call or inquiry call activity is heard at the unit, press:

934 0 ENTER.

The speaker will still be heard when operating keys at the front panel.

To turn the speaker on again, press:

9 3 4 1 ENTER

The speaker volume may be adjusted via the trimpot shown on the Electrical Connection Diagram.

(935) PROGRAM CLEAROUT OPERATIONS

The following list of program codes provides a flexible variety of operations to conveniently clear selected programming items in order to allow for a fresh start.

- 935 0 Clears out phone numbers; sets all delays to default.
- 935 1 Clears out phone numbers only.
- 935 2 Clears out all alarm call grouping linkage.
- 935 3 Sets all delays to default values.
- 935 4 Clears all user recorded messages.
- 935 5 Clears all programming except messages.
- 935 6 Clears all totalizer counts to zero.
- 935 9 Total clearout; ERASES ALL PROGRAMMING AND MESSAGES.

(940) DIAGNOSTIC READOUTS

To assist in analyzing the way the unit is operating, the following list of diagnostic count codes is provided.

- 940 Reads all 4 diagnostic counts (add 0 to clear all 4)
- 940 1 Reads Call In Count (add 0 to clear)
- 940 2 Reads Dial Out Count (add 0 to clear)
- 940 3 Reads Acknowledged Alarm Count (add 0 to clear)
- 940 4 Reads Power Failure Alarm Count (add 0 to clear)

SECTION 7. MAINTENANCE/TESTING/BATTERY REPLACEMENT

Regular testing is the main element of a maintenance program for ongoing autodialer reliability. The test should include interrupting AC power to the dialer for at least 4 hours to verify the gel cell battery maintains dialer operation for that time. You may wish to disconnect the phone cord to avoid nuisance calls during the test period.

The gel cell battery is much like a car battery in that at the end of its life when called on to deliver power, it discharges very quickly without having given any prior warning. The best protection is to replace the battery every 3 years regardless of any test results. The battery is a Power Sonic PS 642, 4 AH 6 volt. It may be ordered from RACO or from Power Sonic in Redwood City, CA, at (415) 364-5001.

SECTION 8. GLOSSARY OF TERMS USED IN THIS MANUAL

ACCESS CODE See Security Access Code.

ACKNOWLEDGEMENT The act of advising the dialer that its alarm message has been heard. This is done either by pressing a touch tone 9 at the prompting beep, or by calling the unit back after the alarm call has ended. Once acknowledged, further activity on that particular channel will not cause further dialing until the expiration of the Alarm Reset Time. See SECTION 5.1, 5.5.

ALARM CALL GROUPING Special programming established to cause specific input channels to cause dialing of only selected phone numbers. Used to provide separate alarm functions according to category of personnel, such as maintenance, security, plumbing, etc. See SECTION 6.1.

ALARM CONDITION For contact input channels, the Alarm Condition is the Open or Closed circuit condition opposite to that which was established as the Normal Condition for that channel. For example, for a channel programmed as Normally Open, the Alarm Condition would be Closed Circuit. Also see Violation. See SECTION 3.3, 5.3.

ALARM CRITERIA The chosen determination of what will constitute an alarm condition (violation) for a given channel. See Normally Closed.

ALARM RESET TIME The period of time, beginning at the moment an alarm is acknowledged, during which alarm dialing on behalf of that specific channel is suspended regardless of further activity of its input circuit. At the end of this period, the Acknowledged Alarm status is cleared for that channel. See SECTION 5.6, 6.

ALARM TRIP DELAY The time required for an input violation to remain in violation before the unit trips into the Unacknowledged Alarm state. See SECTION 6,

AUTOCALL A special test calling function. When Autocall is turned on, the unit places test calls at regular intervals to provide ongoing assurance of dialer and phone line operation. See SECTION 6.

AUTODIALER A device which constantly monitors a set of inputs from various external sensors, and places outgoing alarm calls when there is an alarm condition. If also allows inquiry calls,

AUTOEXTEND A unique feature on the VERBATIM autodialer which automatically extends the available message recording time as required, selecting the optimum speech memory rate for the user's voice message recording. See SECTION 4.2.

CALL BACK See Call Forward.

CALL FORWARD The unit may be commanded from the panel or over the phone, to place a call to a specific phone number. This is called Call Forwarding. If the number called is that of the person commanding the call from a remote telephone, then it is termed Call Back. This is typically done for test purposes. See SECTION 5.8, 6.

CALLOUT The action of the dialer placing calls to outside personnel or facilities.

closed circuit condition one of two possible states of a contact closure input circuit. Closed Circuit is the condition in which the contacts complete the electrical circuit connection. Open Circuit is the opposite condition, in which the contacts do not complete the electrical circuit connection. The Open Circuit condition is electrically equivalent to having no connection to the input circuit. A Closed Circuit input will measure zero volts DC from the input connection to the common connection point. An Open Circuit input will measure 5 volts DC. The Open or Closed Circuit status may also be read without a voltmeter, by use of Program Code 0 ZZ 0, where ZZ is the 2-digit channel number. See SECTION 3.3, 5.3.

COMMON The combined electrical return connection point for all contact closure inputs. One side of all contact inputs are connected to Common. Physically, this Common connection point is any of the 4 terminals marked C on terminal strip IS1. The circuit board internally connects Common to the AC ground (GREEN) terminal on terminal strip IS3. See SECTION 2.

DEFAULT Programming values which are built into the unit and remain in effect until the user alters them. Also, permanently available speech messages which are utilized when the user has not recorded his own messages.

DELAY BETWEEN DIGITS In some applications, an extra waiting time is needed between dialed digits. For example in some PBX systems, a 9 must be

dialed, followed by a waiting time of several seconds before the main phone number may be dialed. See SECTION 3.2, 5.7, 6.

DESIGNATION NUMBER The two-digit "order number of a phone number in the overall set of phone numbers programmed. For example, the designation number for the third phone number is 03. See Programming WORKSHEET A. See SECTION 3.2, 6.1, 6.2.

DIALER See Autodialer.

DRY Description of a sensor contact circuit that is not connected to any power source.

EXIT DELAY A delay period after a user arms the unit, before the unit will actually accept new alarms. Used to allow user to exit a protected entrance without tripping the unit into alarm. See SECTION 6.

GLOBAL Essentially "over all" or "universal". Programming that simultaneously sets the same value for all channels, but excluding the Power Failure Alarm function.

GROUPING See Alarm Call Grouping.

ID MESSAGE See Station ID Message.

INQUIRY CALL A call placed by personnel to the dialer. See SECTION 5.1.

LED A lighted legend indicator on the front panel.

LINK See Alarm Call Grouping.

MEMORY USE RATE See Speech Memory Rate.

NORMAL CONDITION For contact closure inputs, the Normal Condition is that condition (open or closed circuit) which normally exists. The opposite condition would create an alarm. See SECTION 3.3, 5.3.

NORMALLY CLOSED The designation for an input circuit where the sensing contacts are closed in the non-alarm state, and open to indicate an alarm condition. Also, programming of an input channel such that an Open Circuit state will cause an alarm. See also Closed Circuit Condition. See SECTION 3.3, 5.3.

NORMALLY OPEN See Normally Closed.

NON-VOLATILE MEMORY When AC power fails, the unit continues to operate for several hours on its internal Gel Cell battery. When this battery is near discharge, the unit automatically turns itself off. However all the user's programming and all user recorded messages are kept intact by Non-volatile Memory for up to ten years, so when power is later restored, no reprogramming or message recording will be required.

OPEN CIRCUIT CONDITION See Closed Circuit Condition.

POWER FAILURE The disappearance of 120 VAC power to the unit. The unit will continue to operate under power failure until its internal Gel Cell battery is discharged.

RECORDING RATE In the process of digitally recording the user's voice messages into speech memory, the message is recorded into memory at one of four possible rates. The faster this rate of memory usage, the higher the recording fidelity. However, this results in less total available recording time than at slower rates. Rate 1 is the fastest rate giving the best sound quality. The Autoextend feature automatically selects the optimum rate to allow adequate recording time for the user's own set of messages at the best possible sound fidelity. See SECTION 4.2, 4.3.

REPEATS The number of times a series of messages (including Station ID message) is spoken when an alarm call is placed. As used here, this number includes the first recital of the messages. For example, 3 repeats means 3 times total, not 4. See SECTION 5.3, 6.

RING ANSWER DELAY The number of rings required before the dialer will answer an inquiry call. See SECTION 5.3, 6.

RUN TIME METER A feature which, when turned on, accumulates the total number of hours that an input channel is in the Closed Circuit condition. Typically used to monitor equipment operation time, particularly alternating pump systems. See SECTION 3.3, 6.

SCALE FACTOR A translation factor which may optionally be entered in conjunction with the Pulse Totalizer function. The spoken totalizer reading will be the actual number of pulses accumulated, divided the programmed scale factor. See SEC-TION 6.X.

SECURITY ACCESS CODE A code optionally programmed by the user at the front panel. Once programmed, this code is required in order to perform any program operations over the phone. See SECTION 5.7, 6.

SPEECH MEMORY RATE See Recording Rate.

STATION ID MESSAGE A message which is always included in all phone calls to or from the unit, intended to identify the unit. The default Station ID Message is "ID number is 1". See SECTION 4.1, 4.3. TIME BETWEEN ALARM CALLS. With the unit in Unacknowledged Alarm status, the waiting time from the time the unit terminates a given alarm call, until the time when the unit again accesses the phone line to place the next call. During this interval (default 2 minutes), personnel may call the unit back, which will acknowledge the alarm and suspend further calling. See SECTION 5.4, 6.

VIOLATION For contact closure inputs, a violation (also called Alarm Condition) is the Open or Closed Circuit condition which is opposite the condition which has been programmed as Normal for that channel. For example, if a given input channel is programmed for Normally Open operation, then a Closed Circuit is a violation for that input. If the violation persists for the Alarm Trip Delay time, the unit will go into Unacknowledged Alarm state and begin placing alarm calls. See SECTION 3.3, 5.3, 5.6.

SECTION 9. TROUBLESHOOTING TIPS

UNIT IS DEAD; NO LIGHTS OF VOICE.

If the unit will not respond to the ON/OFF key, verify that the battery is connected. Verify that there is 120 volts AC between the WHITE and BLACK wire terminals on TS3. Verify that the fuse (1/4 amp slow blow) is not blown.

UNIT SEEMS OK BUT WILL NEITHER ANSWER NOR DIAL OUT ON PHONE LINE.

This assumes that you hear a voice report at the panel when you press CHECK STATUS. With the NORMAL light lit, test the phone line by pressing DIALOUT. The PHONING light should light and you should hear a dial tone.

If you do not hear a dial tone, open the door of the unit and verify that relay K1 is correctly seated in its socket, with its indentation mark facing downward. Check the phone line and its connection with a DC voltmeter and/or a separate telephone handset. Verify the presence of about 50 volts DC between the RED and GREEN conductors on phone line terminal strip TS2. This voltage will drop to just a few volts when the dialer or other connected phone device goes off hook (PHONING light lit).

If you do hear the dial tone after pressing DIALOUT, press the digits of a valid phone number. You should hear the loud clicks of relay K1 (for pulse dialing) or else the tones of tone dialing, as you press each digit. The dial tone should cease after you have entered the first digit. Continue until you have dialed the complete phone number. You should now hear the sound of ringing and someone answering at the other end. End the call by pressing NORMAL.

UNIT ANSWERS INCOMING CALLS, AND ALSO GOES INTO ALARM WHEN IT SHOULD AND ATTEMPTS TO DIAL OUT, BUT DOES NOT REACH DIALED NUMBER. First, verify whether the unit is actually attempting to dial out, as evidenced by the clicks or tones of dialing followed by message recital. If not, then see the separate problem below, "unit does not go into alarm when it should".

If in the above procedure you do hear the clicks or tones of dialing, but the dial tone does not cease, perhaps your phone system requires the opposite mode of dialing (pulse vs tone) from its presently set mode. Read the present mode by pressing PROGRAM 9 0 1 ENTER. Then set the opposite by entering 9 0 1 1 (to change to tone dialing), or 9

0 1 0 (to change to pulse dialing). Then press NORMAL and then repeat the manual DIALOUT procedure as described above.

Verify that you have programmed complete phone numbers including any area codes or "1" prefixes that might be required to complete the call.

Consider whether your phone system requires a prefix such as 9 to be dialed, followed by a delay period (to access an outside phone line) before dialing out. If so, see SECTION 3.2.

UNIT DIALS OUT BUT WILL NOT ANSWER INCOMING CALLS.

Check programmed ring delay by pressing PROGRAM 9 0 6 ENTER. If it is set for a number larger than one, the dialer is not supposed to answer until the corresponding number of rings has been received. Try setting it back to 1 using code 9 0 6 1 ENTER. If the unit still will not answer incoming calls but is able to dial out, try plugging a regular telephone into the same phone jack in place of the dialer and see if it rings. If the problem is not the phone line, try temporarily connecting test point C to test point D on the main circuit board, for a period of about 5 seconds and see if it "answers" with the PHONING light and a voice report, then call the factory for advice.

UNIT WILL NOT GO INTO ALARM WHEN IT SHOULD. This is usually the result of incomplete understanding of how the dialer manages alarms.

For the dialer to go into Unacknowledged Alarm and Dial Out, a violation must be continuously present for the Alarm Trip Delay time. At least one phone number must be programmed. The unit must not be in the DISARMED state. And, the channel that has the violation must not already be in an acknowledged alarm state, since acknowledged alarm status for a given channel (including power failure) precludes further activity on that channel until that status is cleared. Refer to SECTION 5 for a discussion of how the unit manages alarms.

To clear the acknowledged alarm status of all channels including power failure, starting with the NORMAL light lit, press DISARM/RE-ARM to get the flashing DISARMED indication, then press it again to re-arm the unit with all acknowledged alarm statuses cleared. Now any violations lasting longer

that the Alarm Trip Delay will cause unacknowledged alarms and dialing.

Unacknowledged alarm status is indicated by the corresponding channel number flashing. Acknowledged alarm status is indicated by the same light remaining on continuously without flashing.

If you don't observe this, press PROGRAM and then press 7 0 1 ENTER to check your first phone number. Press 9 0 2 to check the Global (overall) Alarm Trip Delay. For the specific channel ZZ (2 digits) that you are attempting to create an alarm on, also press 6 ZZ to check for any longer Individual Alarm Trip Delay setting.

Check the Normally Open/Normally Closed alarm criteria programming for this channel by pressing 5 ZZ. Make sure it is not set for No Alarm or for Run Time Meter, since these settings would not allow an alarm. Now, for example, if the channel is configured Normally Open, you will want to temporarily provide a closed circuit at its input to trip the alarm. You can directly read and verify the Open/Closed status you are applying by pressing 0 ZZ 0. You may also use a DC voltmeter to trace your circuit connections. With the dialer turned on, an open circuit to a channel contact input reads 5 volts DC with respect to the "C" terminals or electrical around. A closed circuit reads zero volts.

UNIT KEEPS CALLING WHEN IT SHOULD NOT

Be sure that the initial alarm call is in fact being acknowledged. The unit will specifically state "alarm is acknowledged" at the moment you successfully acknowledge the call. The unit will accept a tone acknowledge only following the prompting warble beep.

Also, be sure that the alarm violation has been corrected. Otherwise, even if the alarm is acknowledged, when the Alarm Reset period times out, dialing will begin again.

Write down exactly what the unit recites when it gives the unwanted call. This provides valuable guidance as to the cause and correction of the problem. You may need to lengthen the Alarm Trip Delay in order to minimize nuisance alarms, particularly the power failure Alarm Trip Delay (code 920). If you hear an alarm message with the phrase "now normal" added at the end, it means that the violation occurred long enough to trip the alarm but has returned to normal by the time you are hearing the report. In the case of power failure, if the power has been restored by the time the

message is being heard, the message will be "Power is on". The fact that power is mentioned at all lets you know that there has been a power failure lasting longer than the power failure Alarm Trip Delay. Power will continue to be mentioned in any phone call or front panel status check, until the Alarm Reset time expires.

UNIT IS CONTINUOUSLY "LOCKED" IN ONE STATE, OR IS BEHAVING ERRATICALLY

Erroneous programming or other factors may have caused program lockup. With the unit turn on, use a screwdriver blade to momentarily connect the two pins on Jumper Block JB5 (see Electrical Connection Diagram). If this does not return the unit to normal operation, next try jumping the 2 pins on JB3. This latter step will erase all user programming and recorded messages, so all user programming and messages will need to be re-entered.

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FCC NOTICE TO USERS

- 1. You must notify your telephone utility as follows:
 - a. Intention to install an FCC Part 68-registered device.
 - b. The FCC registration number: HKS-23J06304-AL-R
 - c. The ringer equivalence number: 0.3A
 - d. When the device is disconnected from the telco network and will not be reconnected.
- 2. These units may not be used on party lines.
- 3. The telco has the right to make changes in their network which may affect the operation of your unit, provided adequate notice is given to you in advance to permit continued correct operation.
- 4. In the event of operational problems, disconnect your unit by removing the modular plug from the modular telephone jack. To test the phone line, temporarily plug a working rotary-dial telephone into the jack normally used by the VERBATIM. If the substitute telephone works correctly, your VERBATIM has a problem and should be returned for repairs (in or out of warranty). If the substitute telephone does not work correctly, notify the telco that they have a problem and request prompt repair service (at no cost to the user).
- 5. The user may not under any circumstances (in or out of warranty) attempt any service or repairs on the VERBATIM. It must be returned to RACO for all repairs.

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PROGRAMMING WORKSHEET A

PART 1: PHONE NUMBER PROGRAMMING

2-DIGIT PHONE NUMBER DESIGNATION	USE PROGRAM CODE	PHONE NUMBER (Including any necessary prefixes or area codes)	PERSON
O1 (First)	701		
02 (Second)	702		
03 (Third)	703		
04 (Fourth)	704		
05 (Fifth)	705		
06 (Sixth)	706		
07 (Seventh)	707		
08 (Eighth)	708		
09 (Ninth)	709		
10 (Tenth)	710		
11 (Eleventh)	711		
12 (Twelfth)	712		
13 (Thirteenth)	713		
14 (Fourteenth)	714		
15 (Fifteenth)	715		
16 (Sixteenth)	716		

PART 2: RECORD OF ANY OPTIONAL PROGRAMMING TO ALTER SELECTED PARAMETERS FROM THEIR NORMAL DEFAULT VALUES

PARAMETER DESCRIPTION	DEFAULT VALUE	WRITE IN ANY ALTERED VALUES YOU PROGRAM

EXAMPLE:

902	Alarm Trip Delay	2 seconds	40 seconds
			, , , , , , , , , , , , , , , , , , , ,

WORKSHEET B: ALARM CALL GROUPING PROGRAMMING

Used to "link" certain input chanels to call only selected phone numbers.

PART 1: As an organizational step, write in a Group Description Name (Electrical, Security, etc.) for each of your phone number groups, and the two-digit designation number of the phone numbers you want included in each group. Refer to the filled-in example below. This should be done only after you have already entered your entire list of up to 16 phone numbers on WORKSHEET A.

EXAMPLE:

GROUP DESCRIPTION (Electrical, etc.)	2-DIGIT PHONE # DESIGNATION (taken from WORKSHEET A)	GROUP DESIGNATION (Electrical, etc.)	2-DIGIT PHONE # DESIGNATION (taken from WORKSHEET A)
		Maintenance	01,04,05,06
		Electrical	03, 04
		Security	02, 05

PART 2: For each input channel that you wish to have "linked" to one of your groups, write in your chosen Group Description Name (Electrical, etc.), and the corresponding set of 2-digit Phone Number Designations which you established above. Finally, write in these same sets of 2-digit codes, without the separating commas, to the right of the printed program code (501, etc.). This establishes the complete program code to enter for each channel that you want "linked" to call only a selected group of phone numbers.

Note that any channels that you do not enter such a program code for, will cause dialing of the entire list of phone numbers, when that channel goes into alarm.

EXAMPLE, FOLLOWING PART 1 EXAMPLE ABOVE:

	LINKED	CORRESP. PHONE #	PROGRAM CODE	7	LINKED	CORRESP. PHONE #	PROGRAM CODE
	TO GROUP	DESIG'S EST. ABOVE	TO ENTER	CHAN	TO GROUP	DESIG'S EST. ABOVE	TO ENTER
	-		501 9	01	Security	02.05	501 9 02 05
02			502 9	02	Security	02.05	502 9 02 05
03			503 9	03	Electrical	03. 04	503 9 03 04
04	,	<u> </u>	504 9	04	Maintenance		15049 01 04 05 06
05			505 9	05			505-9
06			506 9	06	Electrical	03.04	506 9 03 04
07			507 9	07			507 9
08			508 9	08			508.9
09			509 9	09			509 9
10			510 9	10	1		510 9
11			511 9				511 9
12			512 9	12			512 9
13			513 9	7 73			513 9
14			514 9	14			514 9
15			515 9	15			515 9
16			516 9	16			516 9
17			517 9	7 77			517 9
18			518 9	18			518 9
19	1		519 9	19			519 9
20	·		520 9	20			520 9
20 21			521 9	21			521 9
22			522 9	22			522 9
23	I		523 9	23			523 9
24			524 9	24			524 9
25			525 9	25			525 9
26			526 9	26			526 9
27			527 9	7 27			527 9
28			528 9	28			528 9
29			529 9	29			529 9
30			530 9	30			530 9
31			531 9	31			531 9
32	1	1	532 9	32			532 9

The above filled-in example is for an 8-channel unit. Three groups were established, and 5 of the channels were linked to a group. The memaining 3 channels were not linked to any group, and therefore, those 3 "unlinked" channels would dial the entire list of phone results in regular order.

WORKSHEET C: MESSAGE PLANNING AND RECORDING

Isolano D	ROX. IGTH
Dockston Dockston	GIR
Dot Normal 2	
10 2 3 3 3 3 3 3 3 3 3	
D. 3 Alorm 1 0 3	
Display	
Cold Alarm 1 0 4	
D. A. Normal 2.0.4	
1	******
D. S. Normol 2 0 5 D. 6	
Description Description	
D. D. O. Normol 2 0 6 D. O. D. O. Normol 2 0 7 D. O. Normol 2 0 7 D. O. Normol 2 0 8 D. O. Normol 2 0 8 D. O. Normol 2 0 8 D. O. Normol 2 0 9 D. O. Normol 2 0 9 D. O. Normol 2 1 0 D. Normol 2 2 0 D. Normo	· · · · · · · · · · · · · · · · · · ·
10 Normal 20 7 Normal 20 8 No Normal 20 8 No Normal 20 8 No Normal 20 9 Normal 20 10 Normal 21 Normal 22 Normal 23 Normal 23 Normal	
Total Alarm	
2	
Chap Alarm	
20 Normal 20 9 20 10 10 10 10 10 10 10	<u> </u>
Ch 10 Alarm	
Ch 10 Normal 2 1 0 0 1 1 1 1 1 1 1	
Ch 1 Normal 2 1 1	
Ch 12 Alarm	Martin District
Ch 2 Normal 2 2 2 2 2 3 3 3 3 3	
Ch 13 Alarm	
Ch 13 Normol 2 1 3 Ch 14 Alarm	
Ch 14 Alarm	
Ch 14 Normal 2 1 4 Ch 15 Alarm	<u> </u>
Ch 15 Normal 2 1 5 Ch 16 Alarm 1 1 6 Ch 16 Normal 2 1 6 Ch 17 Alarm 1 1 7 Ch 17 Normal 2 1 7 Ch 18 Alarm 1 1 8 Ch 18 Normal 2 1 8 Ch 19 Alarm 1 1 9 Ch 19 Normal 2 1 9 Ch 20 Alarm 1 2 0 Ch 20 Alarm 1 2 1 Ch 21 Alarm 1 2 1 Ch 21 Normal 2 2 1 Ch 22 Alarm 1 2 2 Ch 23 Alarm 1 2 2 Ch 23 Alarm 1 2 3 Ch 23 Normal 2 2 3 Ch 24 Alarm 1 2 4 Ch 25 Alarm 1 2 4 Ch 26 Alarm 1 2 5 Ch 27 Normal 2 2 5 Ch 26 Normal 2 2 5 Ch 27 Alarm 1 2 5 Ch 28 Normal 2 2 5 Ch 26 Normal 2 2 6 Ch 27 Alarm 1 2 6 Ch 27 Normal 2 2 6 Ch 27 Normal 2 2 6 Ch 27 Normal 2 2 6 Ch 27 Normal 2 2 6 Ch 27 Normal 2 2 7 Ch 28 Normal 2 2 6 Ch 27 Normal 2 2 7 Ch 28 Normal 2 2 8 Ch 28 Normal 2 2 8 Ch 28 Normal 2 2 8 Ch 28 Normal 2 2 8	
Ch 16 Alarm	
Ch 16 Normal 2 1 6 Ch 17 Alarm	
Ch 17 Alarm	
Ch 17 Normal 2 1 7 Ch 18 Alarm	
Ch 18 Alarm	
Ch 18 Normal 2 3 8 Ch 19 Alarm	ere ere ere ere ere ere er
Ch 19 Normal 2 1 9 Ch 20 Alarm	
Ch 20 Alarm	
Ch 20 Normal	
Ch 21 Alarm	8888 8888 888
Ch 21 Normal	
Ch 22 Alarm	
Ch 22 Normal 2 2 2 2 Ch 23 Alarm	
Ch 23 Normal 2 2 3 Ch 24 Alarm	
Ch 24 Alarm	
Ch 24 Normal 2 2 4 Ch 25 Alarm	
Ch 25 Alarm	XXXXXXXX
Ch 25 Normal 2 2 5 Ch 26 Alarm	**********
Ch 26 Alarm	
Ch 26 Normal 2 2 6 Ch 27 Alarm 1 2 7 Ch 27 Normal 2 2 7 Ch 28 Alarm 1 2 8 Ch 28 Normal 2 2 8	
Ch 27 Normal 2 2 7 Ch 28 Alarm	
Ch 28 Alarm 1 2 8	
Ch 28 Normal 2 2 8	
Ch 20 Norm 1 2 0	
Ch 29 Alarm 1 2 9	
Ch 30 Alarm 1 3 0	· · · · · · · · · · · · · · · · · · ·
Ch 30 Normal 2.3.0	
Ch 31 Alarm 1 3 1	
Ch 31 Normal 2 3 1	
Ch 32 Alarm 1 3 2	
Ch 32 Normal 2 3 2 Total estimated recorded message length in seconds>	



REMOTE ALARMS AND CONTROLS

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SUPPLEMENTAL INSTRUCTIONS FOR THE ALARM READY SCHEDULE FEATURE

DEFINITION

An Alarm Ready Schedule is defined as an interval of time during which the Verbatim is ARMED and "Ready" to respond to alarm conditions. Alarm Ready Schedules can be automatically started according to times and dates entered by the operator. An Alarm Ready Schedule commences with the Verbatim becoming REARMED. (If the Verbatim was previously not DISARMED then the schedule will still be commenced at that time.) Once the Alarm Ready Schedule has commenced the Verbatim will continue in an ARMED state until the end of the Alarm Ready Schedule, at which time the Verbatim will be automatically DISARMED. Once an Alarm Ready Schedule has commenced it is said to be "active".

NOTE: Please review the section of the Verbatim Owner's Manual on the topic of Date/Time entry.

GENERAL DESCRIPTION

Alarm Ready Schedules can be viewed as really nothing more than an automated way of pressing the REARM/DISARM button. Therefore, if an alarm occurs while the Verbatim is DISARMED, no dial-outs will be made and the alarm will be automatically acknowledged. Correspondingly, if there is an acknowledged alarm when the VERBATIM becomes REARMED and the input violation is still present then the Verbatim will begin calling after the trip delay has elapsed.

If the Verbatim is doing a sequence of alarm calls or autocall calls at the time when an Alarm Ready Schedule should change the Verbatim's REARM/DISARM state the change will be delayed until after the end of the calling sequence.

Alarm Ready Schedules can be temporarily overridden by the operator pressing the REARM/DISARM button. However, if the REARM/DISARM button is pressed during an active Alarm Ready Schedule the schedule still remains active. If the operator DISARMs the Verbatim in the middle of an Alarm Ready Schedule the schedule will actually continue as if it were timing an ARMED period(but it is of course DISARMED). It will then switch to the DISARM period and attempt to DISARM the Verbatim just as if the Verbatim was still ARMED. At this point it will be back on its normal sequence. If the operator DISARMs the Verbatim in the middle of an active Alarm Ready Schedule then REARMs the Verbatim once

again before the end of the ARMED period, the schedule will maintain the ARMED period until it's scheduled ending time. The schedule will then DISARM the Verbatim.

Alarm Ready Schedule Modes

There are three possible Alarm Ready Schedules modes: Weekday, Weekend & Holiday. Any combination of these three possible schedules may be enabled at one time. However, the Verbatim may only become REARMED or DISARMED by one mode at a time. (See Alarm Ready Schedule Priorities below.) For example, you may have both weekday & weekend schedules enabled at the same time or you may have all three enabled at the same time. When the Verbatim becomes DISARMED or REARMED by an Alarm Ready Schedule it will verbally announce which mode caused the REARM/DISARM action. The Alarm Ready Schedule modes are as follows:

Mode 1 - Weekday Schedule Mode 2 - Weekend Schedule Mode 3 - Holiday Schedule

For example, if there was a weekday schedule enabled to REARM the Verbatim at 1700 daily, when the weekday schedule became active the Verbatim would say, "REARMED for mode 1". Also, when there is a

local printer connected to the Verbatim, the mode of the Alarm Ready Schedule causing the REARM/DISARM (WEEKDAY, WEEKEND, or HOLIDAY) will be printed along with the current time.

Holiday Schedule Mode

The Holiday schedule is a one-shot, non-recurring schedule which overrides all of the other schedules.

The Holiday schedule will be set by factory default to some Holiday period in the past (such as last Christmas). For the Holiday schedule only, the exact date is entered including the year. Once, the Holiday schedule has been run it is complete and finished until a new schedule, for some date in the future, is entered.

To use the Holiday Alarm Ready Schedule, the operator must enter the REARM date (month/date/year) and DISARM date (month/date/year). For the time-of-day, the Holiday Alarm Ready Schedule always uses the Weekend REARM/DISARM times.

Weekend Schedule Mode

The weekend schedule, if programmed, operates once a week. The weekend schedule is set by factory default to be Friday through Monday unless changed from these defaults. If the defaults are used the Verbatim could be REARMED every Friday afternoon at 1700 and DISARMED again every Monday morning at 0800. The weekend schedule could be changed from the defaults, for example, so that the Verbatim would be REARMED on Saturday and DISARMED on Monday (for organizations with 6 day work-weeks).

When the weekend schedule is enabled the weekday schedule will be overridden. In other words, there would be no DISARMING of the unit at 0800 Saturday morning.

By default, the weekend REARM/DISARM times are set to be the same as the weekday REARM/DISARM times. However, non-default weekend REARM/DISARM times may be entered if the operator so chooses.

Therefore, if personnel regularly leave early on Fridays then the REARM time could be set to 1500 instead of the usual 1700.

Weekday Schedule Mode

The weekday schedule will REARM the Verbatim daily at the programmed weekday REARM time and DISARM the Verbatim daily at the programmed DISARM time. If no weekend schedule is enabled (via the Alarm Ready Control Number settings) then the weekday schedule applies everyday, Monday through Sunday. As noted below, the weekend schedule is overridden by the weekend and holiday schedules.

Alarm Ready Schedule Priorities

There is a priority among the Alarm Ready Schedules. The Holiday Alarm Ready Schedule has the highest priority, then comes the weekend schedule and finally the weekday schedule.

If all three Alarm Ready Schedules are to be active, a Holiday schedule will always start at it's scheduled time & date regardless of the state of the other schedules. When the Holiday schedule is over then the other schedules will resume.

Likewise, the Weekend Alarm Ready Schedule has priority over the Weekday Alarm Ready Schedule. The weekend schedule will always start at it's programmed day-of-week and time regardless of the state of the weekday schedule. When the weekend schedule is over then the weekday schedule will resume.

Programming Alarm Ready Schedule Parameters

The following section explains the VERBATIM codes to be used for programming Alarm Ready Schedules and the Alarm Ready Schedule Control Numbers. Alarm Ready Schedule Schedules parameters may be entered either at the front panel or over the phone.

There are some restrictions which must be remembered when entering DISARM/REARM times and ALARM READY SCHEDULE CONTROL NUMBERS. First, it is not generally possible to "jump" into a schedule when exiting the programming mode. For example, if the current time is 1700 hours and the operator enters a weekday schedule to REARM daily at 1630 and DISARM daily at 0730, this new schedule would not start until the following day at 1630 hours. There is one exception to this rule; if again it is 1700 hours and the operator enters a schedule to REARM at 1705 and DISARM at 0800 then continues doing other programming of the Verbatim until after 1705, when the operator returns the Verbatim to the Normal mode the Verbatim would be REARMED for the weekday schedule.

Second, you cannot enter any holiday date values which will cause the holiday REARM or DISARM date and time to be earlier than the current date and time. As explained below, the holiday schedule uses the weekend times for the time-of-day of the holiday REARM and DISARM.

Finally, it's useful to understand that the Verbatim's internal count-down timers used for REARM/DISARM times are re-calculated as a result of the operator making certain Alarm Ready Schedule programming changes. Anytime a new REARM or DISARM date/time is entered, a calculation is made to determine the next REARM and DISARM for that particular schedule. Also, when the ALARM READY

SCHEDULE CONTROL NUMBER is changed all REARM and DISARM date/times are re-calculated. Further, whenever the current date or time is set or changed by the operator all REARM and DISARM date/times will be re-calculated.

CODE 961:

READ WEEKDAY REARM & DISARM TIME (defaults: 1700 & 0800)
Press 9 6 1 then (enter) to hear the Weekday REARM
& DISARM times recited. Times will not be altered
and new REARM & DISARM values will not be calculated.

SET WEEKDAY REARM & DISARM TIME

Press 9 6 1 plus REARM & DISARM time.
For example, 961 1600 0700 then (enter)
to set REARM time to 1600 (4:00 P.M.) & DISARM time to 0700
(7:00 A.M.) The user is allowed to enter just the REARM time,
ie; 961 1600 (enter). But, if the user wants to change
the DISARM time then both the REARM & DISARM times must be
entered.

CODE 962:

READ WEEKEND REARM & DISARM TIME (defaults: 1700 & 0800)
Press 9 6 2 then (enter) to hear the Weekend REARM
& DISARM times recited. Times will not be altered
and new REARM & DISARM values will not be calculated.

SET WEEKEND REARM & DISARM TIME

Press 9 6 2 plus REARM & DISARM time then (enter) For example, 962 1500 0700 then (enter). to set REARM time to 3:00 P.M. & DISARM time to 7:00 A.M. The user is allowed to enter just the REARM time, ie; 962 1500 (enter). But, if the user wants to change the DISARM time then both the REARM & DISARM times must be entered.

CODE 963:

READ WEEKEND REARM & DISARM DAY-OF-WEEK (defaults: Fri. & Mon.)
Press 9 6 3 then (enter) to hear the Weekend REARM
& DISARM day-of-week recited as a number from 1 to 7.
Note: Sunday = 1, Monday = 2, etc. Day-of-week will not be altered and new REARM & DISARM values will not be calculated.

SET WEEKEND REARM & DISARM DAY-OF-WEEK
Press 9 6 3 plus REARM & DISARM d-o-w then (enter).
For example, 963 6 1 then (enter) to set the weekend REARM day-of-week to Friday & REARM day-of-week to Sunday.
The user is allowed to change only the REARM d-o-w if so desired, eg; 963 7 (enter) to set the REARM d-o-w to Saturday. But, if the user wants to change the DISARM d-o-w then both the REARM d-o-w & DISARM d-o-w must be entered.

CODE 964:

READ HOLIDAY REARM DATE (default: 12/24/90)

Press 9 6 4 then (enter) to hear the Holiday REARM date recited. The Holiday REARM will not be altered.

SET HOLIDAY REARM DATE

Press 9 6 4 plus REARM date. For example, enter 964 12 24 91 (enter) to set holiday REARM date to December 24, 1991.

NOTE: Unlike the current date entry (CODE 9 4 1) the day-of-week date cannot be entered.

CODE 965:

READ HOLIDAY DISARM DATE (default: 12/26/90)

Press 9 6 5 then (enter) to hear the Holiday DISARM date recited. The Holiday DISARM will not be altered.

SET HOLIDAY DISARM DATE

Press 9 6 5 plus REARM date. For Example, enter 965 12 26 91 (enter) to set holiday DISARM date to December 26, 1991.

NOTE: Unlike the current date entry (CODE 9 4 1) the day-of-week date cannot be entered.

CODE 966:

READ ALARM READY SCHEDULE CONTROL NUMBER (default: 0)
Press 9 6 6 then (enter) to hear the Alarm Ready Schedule
Control Number recited. The Control number will not be
altered and new REARM & DISARM values will not be calculated.
SET ALARM READY SCHEDULE CONTROL NUMBER

Press 9 6 6 C to set the Alarm Ready Schedule Control Number, where C is a control number described below.

ALARM READY SCHEDULE CONTROL NUMBER HAS THE FOLLOWING MEANING: 0 - OFF No Alarm Ready Schedules executed. Also used to reset any active Alarm Ready Schedules.

1 - Only the Weekday Alarm Ready Schedule will be active. (Daily: Monday-Sunday) Default: REARMED everyday 1700 & DISARMED everyday 0800.

2 - Only Weekend Alarm Ready Schedule will be active. Default: REARM every Friday 1700 & DISARM every

Monday 0800.

3 - Both Weekday & Weekend Alarm Ready Schedules will be active.

Default: REARM daily at 1700 Monday-Thursday & DISARM daily at 0800 Tuesday-Friday. REARM Friday at 1700 & DISARM Monday at 0800.

4 - Only Holiday Alarm Ready Schedule will be activated.

Default: REARM at 1700 December 24, 1990 then

DISARM at 0800 December 26, 1990

5 - Both Holiday & Weekday Alarm Ready Schedules will be activated.

Default: REARM daily at 1700 & DISARM daily at 0800.
REARM at 1700 December 24, 1990 then

DISARM at 0800 December 26, 1990.

6 - Both Holiday & Weekend Alarm Ready Schedules will be activated.

Default: REARM every Friday at 1700 then DISARM every Monday at 0800.

REARM at 1700 December 24, 1990 then DISARM at 0800 december 26, 1990.

7 - Holiday, Weekend & Weekday Alarm Ready Schedules will be activated.

Default: REARM daily at 1700 Monday-Thursday then DISARM daily at 0800 Tuesday-Fri.
REARM every Friday at 1700 then DISARM every Monday at 0800.

REARM at 1700 December 24, 1990 then DISARM at 0800 December 26, 1990.

NOTE: Whenever a new Alarm Ready Schedule Control Number is entered all REARM & DISARM values will be recalculated. Any active Alarm Ready Schedules will be halted and the Verbatim will be left in which ever REARM/DISARM state it was last in.

FACTORY DEFAULTS

Weekday REARM time 1700
Weekday DISARM time 0800
Weekend REARM day-of-week Friday
Weekend DISARM day-of-week Monday
Weekend REARM time 1700
Weekend DISARM time 0800

NOTE: Both Weekend times are initially the same as their respective Weekday times but are settable by operator.

Holiday REARM date 12/24/90 Holiday DISARM date 12/26/90

Holiday REARM time always same as Weekend REARM time always same as Weekend DISARM time

Alarm Ready Control Number 0 (all schedules disabled)

WEEKDAY AND WEEKEND ALARM READY SCHEDULE PROGRAMMING EXAMPLE

For the following example assume there are personnel present at a plant being monitored by the Verbatim during normal business hours, Monday through Friday, 7 A.M. to 4 P.M. And that there is someone at the plant every Saturday from 7 A.M. until 12 Noon. Therefore, those personnel would be aware of any alarm conditions at the plant and would not want the Verbatim to be making calls to phone numbers in it's phone number list. Then the Verbatim should become REARMED every weekday evening at 1600 and become DISARMED every weekday morning at 0700. Also, the Verbatim should become REARMED every Saturday at 1200 noon and stay in the ARMED state until it is DISARMED every Monday at 0700.

- Step 1) Make sure the current time is during one of the times when the Verbatim should be DISARMED, ie; during the workday hours. This is necessary since any Alarm Ready Schedule begins with the Verbatim becoming REARMED and ends with the Verbatim becoming DISARMED. If the user were to set up a repeating Alarm Ready Schedule (weekday or weekend) during the time the Verbatim was to be ARMED, the programmed schedule would not actually begin until the next time that schedule was to take effect. For example, if the current time was 1630 and a weekday schedule was being programmed, that weekday schedule would not actually start until the next day at 1600.
- Step 2) Press the "PROGRAM" key to put the Verbatim into the program mode.
- Step 3) Set the current date and time: (if not already set)
 Enter CODE "941 MM DD YY d" followed by "enter"
 Where MM = 2 digits for month, DD = 2 digits for date,
 YY = 2 digits for year, and d = 1 digit for day-of-week.
 Enter CODE "942 HH MM SS" followed by "enter"
 Where HH = 2 digits for hours, MM = 2 digits for minutes,
 SS = 2 digits for seconds.

- Step 4) Set the Weekday REARM/DISARM times:
 Enter CODE "961 1600 0700" followed by "enter"
 to set the REARM time to 1600 and the DISARM time to 0700.
 - Step 5) Set the Weekend REARM/DISARM times:
 Enter CODE "962 1200 0700" followed by "enter"
 to set the weekend REARM time to 1200 and the weekend DISARM time to 0700.
 - Step 6) Set the Weekend REARM/DISARM day-of-week:
 Enter CODE "963 7 2" followed by "enter" to set the weekend
 REARM day-of-week to Saturday and the Weekend DISARM day-ofweek to Monday.
 - Step 7) Enable both the Weekday and Weekend Alarm Ready Schedules:
 Enter CODE "966 3" followed by "enter" to set the Alarm
 Ready Schedule Control Number to 3 and enable both the
 Weekday and the Weekend Alarm Ready Schedules.
 Note: If the Verbatim is configured with a local printer a
 summary of all of the REARM and DISARM times will be printed.
- Step 8) Return to the Normal mode and make sure the Verbatim is DISARMED.

TIME AND DATE SETTING:

Use Program Code 935 7 ENTER to start the real time clock chip. This needs to be done only once at the time of the installation of the chip.

Time and date may be set or corrected with the following programming code entries:

941 ENTER to check the date.

941 MM DD YY D ENTER to set the date.

MM is the month (03 for March); DD is the date (07 for the 7th day of the month); YY is the year (89 for 1989); and D is the day of the week (1 for Sunday; 2 for Monday, etc.). Entry of D is optional.

942 ENTER to check the time.

942 HH MM SS ENTER to set the time.

HH are the hours in military time (13 for 1 PM); MM are the minutes (09 for 9 minutes); and SS are the seconds. Entry of SS is optional.

935 7 ENTER clears the time and date back to 00:00:00 on 01/01/89.



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Enhanced Telephone Interface Features

The Enhanced Telephone Interface Features give the user additional power to solve unusual telephone system interface problems and to provide more reliable and expeditious notification of alarms.

The Enhanced Telephone Interface Features include the following functions:

60 Digit Phone Numbers

For all 16 telephone numbers and the call-back number.

Telephone Line Fault Detection (Phone Fault)

Tests phone line at regular programmed interval

Flashes LED on dialer front panel upon failure

Logs Phone Faults and phone line restoration to Local Printer

Automatic Selection of Tone versus Pulse Dialing

Tests for tone capability upon first power up without user intervention

May be overridden for PBXs with "non-standard" dialtones

Call Progress Monitoring (CPM)

Detects busy and ringing signals

Waits until phone is answered to annunciate voice reports

Abandons call if busy or no answer and quickly tries next number

Numeric Pager Support

Designate Pager only numbers - no voice annunciation

Insert pager system terminator characters such as '#' or '*'

Insert DTMF A, B, C & D tones in phone number strings for unique IDs

PBX Support

Ignore "non-standard" PBX dialtones

Insert "wait for outside line" dialtone into phone number strings

The Enhanced Telephone Interface Features are include on Verbatims and Verbatim Gateways with a mainboard Revision of VMP-5a and above and firmware revisions 2.09 and above.

60 Digit Phone Numbers

Telephone numbers may be as long as 60 digits. This allows, for instance, for the Verbatim to make long distance calls using long distance companies which require entry of access codes. Even with many digits occupied by long distance numbers and access codes there will still be

sufficient digits remaining for calls to pager systems requiring complex sequences of terminators, ID numbers, time delays, tone detects, etc.

Telephone Line Fault Detection (Phone Fault)

The Phone Fault Detection feature tests the telephone line whenever the unit needs to make a phone call and at a regular programmable time interval (as long as there are phone numbers programmed).

Phone Fault is turned ON by default but may disabled if so desired. Also, the Phone Fault Detection interval is user programmable.

Phone Fault shares a user code with the Automatic Tone/Pulse Selection capability. The basic user command is code 917. Entering code 917 with no parameter will cause a recitation of the current settings for Phone Fault and Automatic Tone/Pulse Selection.

The following parameters may be entered:

- -> 917 0 turns OFF BOTH Phone Fault Detect and Auto. Tone/Pulse Select
 - 917 1 turns ON Phone Fault Detect, turns OFF Auto. Tone/Pulse Select
 - 917 2 turns OFF phone fault detect, turns ON Auto. Tone/Pulse Select
 - 917 3 turns ON **BOTH** Phone Fault Detect and Auto. Tone/Pulse Select (default)

NOTE: The factory default setting for code 917 is parameter 3; **BOTH** Phone Fault Detect and Auto. Tone/Pulse Select ON.

The command code 916 is used to set the Automatic Phone Fault Detection interval. This time interval can range from 0.1 hour to 24 hours. The factory default setting is 24 hours. Enter the command 916 followed by a value from 0.1 to 24.0 to program the Phone Fault Detection interval.

EXAMPLE: Enter 916 0.3 to set the Phone Fault Detection interval to 0.3 hour.

Whenever a Phone Fault is first detected, a Local Data Logger (LDL) message will be sent to the printer with date and time stamp. Additionally, the Phone Fault LED, labeled **TFAIL**, will begin to blink.

If a Phone Fault is detected at the beginning of an outgoing phone call the TFAIL LED will flash and the unit will return to the NORMAL state. Then, while still in the NORMAL state, the unit will continually check the telephone line every 30 seconds for restoration of the telephone service.

When telephone service is restored, a message will be sent to the Local Data Logger's printer and the TFAIL LED will go from flashing to solid ON. The Verbatim will then resume making any pending phone calls. The TFAIL LED will remain ON until a voice message about the Phone Fault is communicated via the phone or to an operator at the front panel. The TFAIL LED and pending voice annunciation of the Phone Fault condition may also be cleared at the front panel by pressing the DISARM/RE-ARM button twice.

No Phone Fault Detection will be performed if there are no phone numbers programmed. If the unit needs to make an alarm call when there is a Phone Fault the numbered channel LEDs will blink continuously even though the unit is in the NORMAL state. This unusual condition will only be seen while there is a Phone Fault and the unit is constantly testing for the return of telephone service.

Automatic Tone/Pulse Selection

When Automatic Tone/Pulse Selection is ON the Verbatim will test for the ability to use tone dialing. This test will be performed only once; one minute after the unit is powered on or is reset.

Automatic Tone/Pulse Selection shares a user code with Phone Fault Detection. The basic user command is code 917. Entering code 917 with no parameter will cause a recitation of the current settings for Phone Fault and Automatic Tone/Pulse Selection.

The following parameters may be entered:

- 917 0 turns OFF BOTH Phone Fault Detect and Auto. Tone/Pulse Select
- 917 1 turns ON Phone Fault Detect, turns OFF Auto. Tone/Pulse Select
- 917 2 turns OFF phone fault detect, turns ON Auto. Tone/Pulse Select
- 917 3 turns ON **BOTH** Phone Fault Detect and Auto. Tone/Pulse Select (default)

NOTE: The factory default setting for code 917 is parameter 3; **BOTH** Phone Fault Detect and Auto. Tone/Pulse Select ON.

Setting Automatic Tone/Pulse Selection ON when it was previously OFF will cause the Verbatim to perform the test for Tone/Pulse Selection even though is has been longer than one minute since the unit was last powered on or reset.

After powering the unit on, Automatic Tone/Pulse Selection may be temporarily suspended by any front panel activity. Automatic Tone/Pulse Selection will then be resumed one minute after the front panel activity has ceased.

No Tone/Pulse Selection will be done while the unit is being programmed over the phone or if there are no phone numbers programmed.

Automatic Tone/Pulse Selection enables the installer to not be concerned about whether the telephone line supports tone dialing. It's possible to simply turn on the unit, immediately program phone numbers, recorded messages and any other programmable features, then return the unit to the NORMAL state. Then, selection of tone or pulse dialing will be done automatically.

Call Progress Monitoring (CPM)

Call Progress Monitoring (CPM) operates by listening for the presence or absence of busy and ringing signals. These are the same signals you hear after you dial a phone number. Proper operation of CPM requires that the busy and ringing signals are composed of standard Call Progress frequencies. The possibility exists that CPM may not function properly because the CPM tones on a particular phone system are not standard.

Unlike other equipment with Call Progress Monitoring, CPM on the Verbatim does not include detection for the dial tone at the beginning of the dialout session. However, dialtone detection is a integral part of Phone Fault Detection. This allows CPM to be operational even when the Verbatim is installed inside of a PBX phone system which has a non-standard dialtone.

CPM is intended to detect the following phone line states:

phone line is busy - both subscriber and trunk busy signals are detected non-existent phone number phone unanswered - still ringing phone answered - ringing stopped

When CPM determines that a call is not complete an appropriate report will be sent to the LDL printer.

Reasons for a non-completed call:

CPM determines the line is busy

CPM does not detect cessation of ringing before end of programmed CPM ring count

CPM does not detect either busy signal or valid ring signals

Reason for a completed Call:

CPM detects at least one ring followed by cessation of ringing

If a call is not completed, the Verbatim will hang up and enter the intercall delay state. At the end of the intercall delay the next programmed telephone number will be dialed. When a call is not completed the intercall delay will always be shortened to 30 seconds. This CPM altered

intercall delay is fixed at 30 seconds and is not affected by the user programmed intercall delay. The normal programmable intercall delay will apply only to the delay between completed calls.

Call Progress Monitoring is set to OFF by factory default. If CPM is OFF the Verbatim will deliver voice messages without regard to any ringing or busy signals. The unit will simply dial the number, then after a short delay, start enunciating voice reports.

As noted above, dialtone detection is actually a part of the Phone Fault Detection feature. It is possible to have CPM turned OFF and Phone Fault Detect turned ON. In this case, the unit will test for a dialtone but not for busy or ringing signals.

Use code 900 to read or set CPM programming. Use code 900 followed by a 1 or 0 parameter to program CPM ON (1) or OFF (0).

The CPM ring count is the number of rings the Verbatim will wait for an answer before considering the call to be incomplete. Use code 918 to read or set the number of CPM rings. The factory default is 10 rings and the user may program any number of rings from 5 to 20.

Example: Enter 918 10 then ENTER to program the CPM ring count to 10 rings.

Numeric Pager Support

Support for Numeric Pagers is comprised of a number of Verbatim features:

Ability to add delays into a phone number string

Often needed to pause after dialing the pager system's digits and emitting the caller's ID digits in the phone string.

Ability to add DTMF # (or DTMF *) into a phone number string

Often needed as a terminator character to inform the paging system that the last digit has been entered

Ability to add a pause for tone detect anywhere in the phone number string Sometimes used to detect the paging system's beep(s) heard after it answers.

Ability to defeat voice annunciation for a specific phone number

Often just dialing the pager system and emitting a DTMF ID sequence is sufficient for that phone call. Voice reports only delay the calling of subsequent numbers.

Ability to add DTMF A, B, C and D tones to phone number string

These DTMF characters don't appear on standard telephones and may be used to
differentiate automation equipment from humans calling the paging system.

Except for simple delays, entry of these additional digits into a phone number string requires a

two key sequence. For example, to enter a '#' character into a phone number string, either at the front panel or over the phone, press the '*' key followed by the 8 key. This two key sequence will enter the single '#' character into phone number string.

The complete list of special digits is as follows:

Desired Result	User Enters	Voice Speaks
DTMF 'A' in phone string	*1	A
DTMF 'B' in phone string	*2	В
DTMF 'C' in phone string	*3	С
DTMF 'D' in phone string	*4	D
No voice annunciation for this number	*5	PHONE
Pause for tone detect	*6	TONE
DTMF '*'	*7	STAR
DTMF '#'	*8	POUND

Consider the following example of needing to make a call to a paging system. The pager system's phone number would be entered followed by a tone detect to wait for the pager to beep. After that, some kind of ID number would be entered. Often the ID number would simply be the phone number at the Verbatim's site. Finally, add the character to make this phone session only be a pager call and not to do voice annunciation. Additional delay digits may be necessary for proper timing of the pager call session. Please refer to Appendix G regarding pager session timing.

The phone number string for the above example with the first phone number calling a pager: 7016586713*618007226999*8*5

PBX Support

Interfacing the Verbatim to PBX or PABX phone systems can occasionally present problems. Some PBXs have a non-standard dialtone. Additionally, in many PBXs, you must first press a special key, like a '9', to get an outside line. After pressing the '9' there may be a short delay followed by the dialtone for the outside line.

By turning OFF Phone Fault Detection you can avoid problems with non-standard dialtones from

you PBX system. Then Phone Fault Detect will not falsely indicate a telephone line interruption.

Even with Phone Fault Detect OFF you can still accomplish dialtone detection on outside lines. Simply add the Tone Detect key sequence to the phone number string after the '9' or other digit to request an outside line.

Cautionary Notes About Interfacing to PBXs Must Be An Analog Line

Some PBX systems are either partially or entirely digital. That is, voice and signaling information is converted to a digital representation. Voice information arriving at the PBX from the outside is converted from analog to digital. Voice information leaving the PBX to the outside is converted from digital to analog. Phonesets within a digital system may be interfaced by digital signals only. In such systems it may be difficult, but usually not impossible, to obtain a "standard" analog phone line to use in interfacing devices such as a Verbatim. It may be necessary to contact the vendor of your PBX system for information on adding analog lines.

Lines Can Cause Damage

Caution is advised. Some telephone lines within digital PBXs present voltages which can be dangerous to Raco's equipment. If you are attempting to interface a Verbatim inside of a PBX it would be a good practice have the phone line you intend to use checked for "unusual" voltages and signals.

With few exceptions, if you can get a standard telephone set to work on a PBX line then you will be able to make the Verbatim work as well.

Program Codes for the Enhanced Telephone Interface Features

Code	Description	Default	Range	Notes
900	Read/Set Call Progress Monitoring ON or OFF	0 (OFF)	none, 0 or 1	
916	Read/Set Automatic Phone Fault Detect. frequency	24 hours	0.1 to 24 hrs.	916 . resets to default
917	Read/Set Phone Fault AND Auto. Tone/Pulse Select ON or OFF	3	0 to 3	0 = BOTH OFF 1= Phone Fault ON, Auto. Tone/Pulse OFF 2 = Phone Fault OFF, Auto. Tone/Pulse ON 3 = Phone Fault ON, Auto. Tone/Pulse ON
918	CPM Ring Count	10	5 to 20	918 . resets to default

KEEP THIS FOR YOUR RECORDS

LIMITED WARRANTY

WARRANTY CERTIFICATE

Raco Manufacturing and Engineering Co Inc., Emeryville California warrants this product to be in good working order for riod of five years from the date of purchase as a new product. In the event of failure of any part(s), due to defect in material or workmanship occurring within that five year period, Raco will, at its option, repair or replace the product at no charge for parts or labor. Any alteration of the product without instruction from Raco's Engineering Department will automatically void this warranty. If alterations of the unit are authorized by Raco, please complete the authorization form in the Owners Manual and return the form to Raco to ensure the warranty. Under no circumstances will Raco be responsible for consequential or secondary damages.

The defective product should be returned, insured and freight prepaid, securely packaged to the address listed below. Please call 1-800-722-6999 for a Return Authorization Number. Please include a copy of your sales receipt, the dialers serial number, and a detailed description of the problem you are experiencing.

Raco Manufacturing and Engineering Co Inc.	
Service Department	
1400 62nd Street	
Emeryville, CA 94608	Detach here before mailing
WARRANTY REGISTRATION	
IMPORTANT: Within 14 days of purchase, please compete this Warranty Registratio and drop in the mail. Postage is paid if mailed in the US. Otherwise, please return Raco Manufacturing and Engineering Co Inc. 1400 62nd Street Emeryville, CA 94608	n. Detach the top portion, fold in half to:
Market: Verbatim VDFP-4C	
Number V4-3550-0000	
Date of Purchase	
Name	
Title/Position	
Company/Organization	
Division/Department	
Address	
Telephone	
Dealer's Name	
Address	
The following additional information will assist us in our continuing efforts to provide you with products that meet your specific requirements. 1. This autodialer is used in:wastewater,gas pipeline,remote equipmentcold storage,chemical manufacture,energy generation,agriculture,other. 2. It uses the following types of transducers:pressure,temperature,flow,electrical detection,gas (all types),intrusion,	Picase send me more information on the following quality products from Raco Manufacturing:Chatterbox CB-4/8Chatterbox CB-16,24,32VerbatimRemote Supervisory ControlAnalog Inputs
	Nema 4X enclosure Local Data Logging Central Data Logging
rade show,professional association,magazine inquiry, other.	Data Acquisition SystemExtended Warranty
4. I read the following publication(s) regularly:	

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COMPLETE AND RETURN WITHIN 14 DAYS

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	BUSINESS REPLY MAIL FIRST CLASS MAIL PERMIT NO.1007 EMERYVILLE, CA POSTAGE WILL BE PAID BY ADDRESSEE	

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APPENDIX C-5 Effluent Water Pump

COMPRESSOR-PUMP & SERVICE 2400 SOUTH 3333 WEST SALT LAKE CITY, UT 84119 (801) 973-0154 (801) 973-9546 FAX

TO: ROBERT RIMARDS

20 LKT TR:28



COMPANY: RICHARDS LAB FAX: 785-2521 FROM: MITCH TICE

DATE: 9-9-94

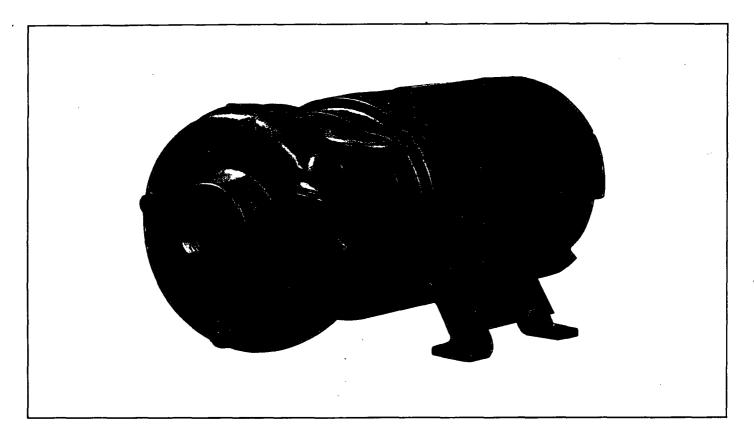
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ALL OF IF YOU DO NOT RECEIVE THESE PAGES, PLEASE CALL (801) 973-0154 OR FAX (801) 973-9546



General Information

The Model SMP standard motor pump is a singlestage, end suction, closed or semi-open impeller, general purpose pump. They are close coupled to a motor driver, industry standard NEMA design, and are constructed for continuous operation. Back pullout design and maximum parts interchangeability combine to provide easy maintenance.

The SMP product line is available in 3 models: 1000 series, 2000 series, and 3000 series.

Construction

Casing:

- 1000—Cast iron, (optional 316SS), end-suction, tangential discharge with back-pull-out design.
- 2000—All iron or bronze fitted, end suction, tangential discharge with back-pull-out design.
- 3000—All iron or bronze fitted, end suction, tangential discharge with back-pull-out design.

Stuffing Box: Self-aligning mechanical seal with stainless steel parts, positioned by the impeller and used for general or hot water service.

impeller:

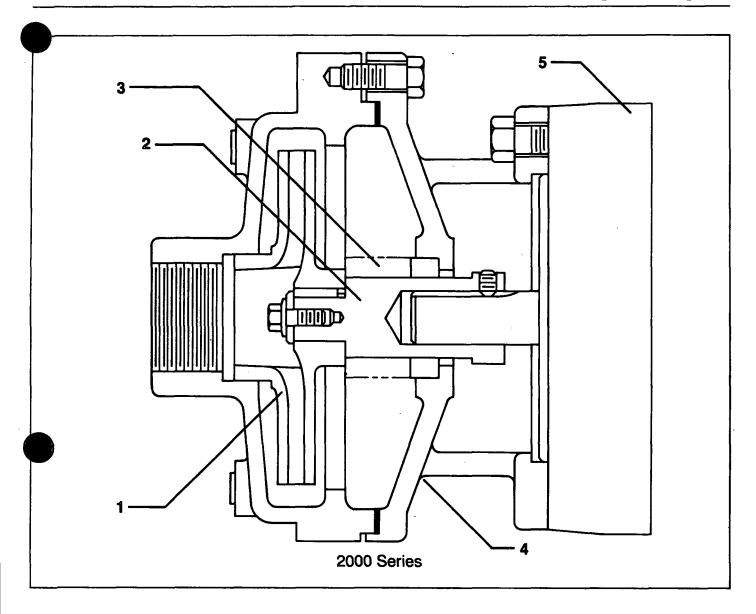
 1000—Ryton single suction, semi-open and threaded to shaft. (Optional cast iron or 316SS)

- 2000—Ryton single suction, closed and keyed to shaft. (Optional cast iron or bronze)
- 3000—Cast iron or bronze single-stage, closed design and keyed to shaft.

Shaft:

- 1000—416SS stub shaft secured to the motor shaft. (Optional 316SS material)
- 2000—416SS stub shaft secured to the motor shaft.
- 3000—Shaft is integral with motor shaft protected with 416SS shaft sleeve

Bearings: Located in motor.



Design Features

- High-efficiency impellers for low energy consumption and greater output per horsepower.
- Corrosion-resistant shafts or sleeves for long life with minimal maintenance. 1000 and 2000 series offer stub shafts for flexibility in motor selection. 3000 series are offered with replaceable shaft sleeves.
- 3. Maintenance-free seal featuring a self-aligning design that requires no adjustment.
- Back pull-out casing construction which eliminates the need to disturb piping while performing inspection/ maintenance.
- NEMA Standard Motors for maximum flexibility, interchangeability and versatility.

Materials Of Construction

Pump Series	1000, 2000 & 3000	2000 & 3000	1000 & 2000	1000		
Material Column Description	All iron	Bronze Fitted	Reg. Fitted	316 Stainless		
Pump Parts						
Casing		Cast Iron-Class 30	•	316 SS-Class 30		
Impeller	Cast Iron-Class 25	Bronze	PPS	316 SS-Class 30		
Stub Shaft (2)		416 Stainless Steel		316 SS		
Motor Shaft		Steel				
Shaft Sleeve (3)	416 Stain					
Flinger (3)	PF		_			
Support Head		Cast Iron-Class 30		316 SS-Class 30		
impeller Key (4)	Carbon	n Steel		-		
Impeller Cap Screw (5)		18/8 Stainless Steel		316 SS-Gr. C83600		
impeller Washer		18/8 Stainless Steel		SS Bar		
Casing Gasket (1)		Non As	bestos			
Casing Bolts	Alloy Steel					
Pipe Plugs		316 SS				
Bed Plate	Steel					
Mechanical Seal	Stainless Steel Construction					

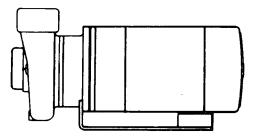
Footnotes: (1) Fiber used on all 2000 Series pumps and the 3×3×5 and 3×3×6 SMP-3000 Series sizes.

- (2) Used on 1000 & 2000 Series pumps only
- (3) Used on 3000 Series pumps only
- (4) Used on 2000 & 3000 Series pumps only
- (5) Impeller cap screw on 2000 series pumps only are 18 chrome/4 nickel precipitation hardened. Commercial spec A-286.

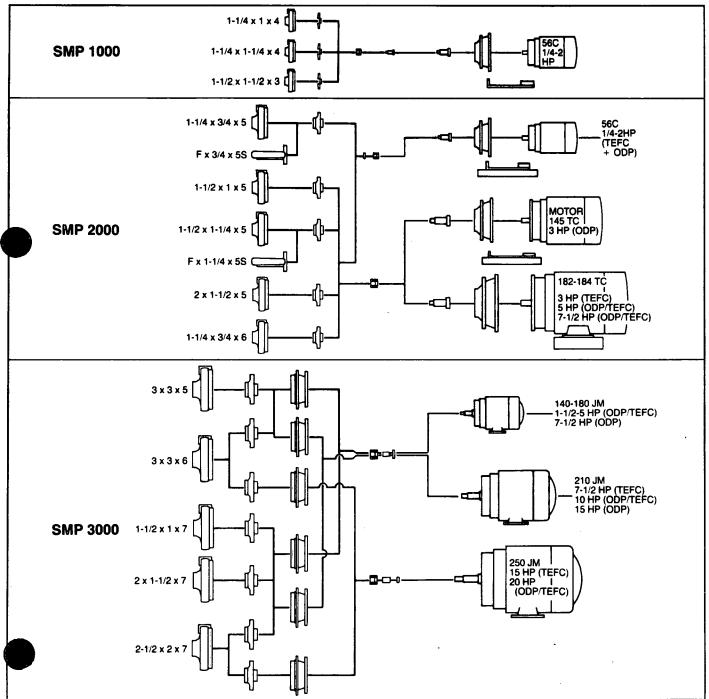
Material Specifications

General Description	Specification	General Description	Specification
Cast Iron-Class 30	ASTM-A48	316 Stainless Steel-Class 30	ASTM-A296 Gr. CF-8M
Cast Iron-Class 25	ASTM-A48	416 Stainless Steel-Class 30	ASTM-A528 Type 416
Bronze	ASTM-B584 Gr. C83600	316 Stainless Steel-Gr. C83600	ASTM-A276
PPS	Glass Reinforced Polymer	Carbon Steel	Cold Drawn Key Stock
Alloy Steel	ASTM-A574 Heat Treated	18/8 Stainless Steel	AISI—Type 304

waximum Interchangeability



The SMP's maximum interchangeability minimizes spare parts inventory requirements.





Engineering Information (English Units)

Pump Series	10	00 Seri	es			20	00 Ser	ies				30	00 S	eries	
Pump Size	11/4×1		1½×1½		F×3/4		1½×1¼		1	11/4×3/4	3×3	3×3	11/2>	1	
Oneima Data	×4	×4	×3	×5	×5S	×5	×5	×5\$	×5	×6	×5	×6 [,]	×7	7 × 7	×7
Casing Data	11/4	4,,	4.,		_,	447	4.,			4,,	ا م ا	_	1		0.7
Suction Size (NPT)	1 1	11/4	11/2	11/4 3/4	Flange			Flange	l .	11/4	3 3	3 3	11/	- -	21/2
Discharge Size (NPT)	'	11/4	1 1/2	1 44	3/4	1	11/4	11/4	11/2	3/4	3	3	1 1	11/2	2
Working Pressure	HOO (E)	100 (5)	100 (5)	1.00	100	400	100	100	100	100	100	100	1.5		150
(PSIG)	100 (3)	100 (5)	100 (5)	100	100	100	100	100	100	100	100	100	150	0 150	150
Hydrotest Pressure	HEO (E)	HEO (E)	150 (5)	1.50	150	450	150	150	150	1.50	1.50	450	000	- 005	005
(PSIG)			150 (5)		150	150	150	150	150	150	150	150	22	l l	
Nozzle Ratings (NPT)	150#	150#	150#	150#	150#	150#	150#	150#	150#	150#	150#	150#	1		
Casing Thickness (Nom)	.25	.25	.25	.19	.19	.19	.19	.19	.19	.19	.31	.31	.38	.	.38
Drain Tap Size (1)	/8	/8	1/8	1⁄8	1∕8	1⁄e	1/8	1/8	1/8	1/8	1/4	1/4	1/4	1/4	1/4
Suction/Discharge	١,,	.,	.,	/ ₍₀₎	(0)	(0)	(0)	(0)	(0)	(0)	 (0)	(0)	١.,	.,	١.,
Gage Tap Size (1)	1/8	1/8	1/8	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	1/4		1/4
Seal Flush Tap Size (1)	1/8	1/8	1/8	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	1/4	, , ,	1/4
Min. Front Imp. Clearance	.010	.010	.010	.015	.015	.015	.015	.015	.015	.015	.015	.015	.01	-	1
Min. Back Imp. Clearance	-	_	_	-	-	_	-		-	-	_	_	-	.015	.015
Driver Frame		56C		56	C. (4)		145TC		182-18	4TC	140JN	1 18	ОЈМ	210JM	250JM
Stuffing Box Data								1					1		
Seal Size		3/4		ł	3/4		11/4		11/2	4	11/4	1	1/4	11/4	15⁄a
Shaft & Bearing Data]			ŀ				İ				ı			
Dìa. @ Impeller		.50	1). (625		.625	1	.62	5	.8745	.8.	745	.8745	1.2495
Shaft End Mtr. Brg.		203		2	203		205		200	6	205	2	06	209	209
E.O.S. (2) Mtr. Brg.	201 (1	HP ma	x)/203	2	203		203	İ	20	5	203	2	05	205	207
Min. B10 Brg. Life (3)		9 Yrs.		15	Yrs.		12 Yrs.		9 Yı	s.	20+ Yr	s. 4 `	Yrs.	2 Yrs.	5 Yrs.

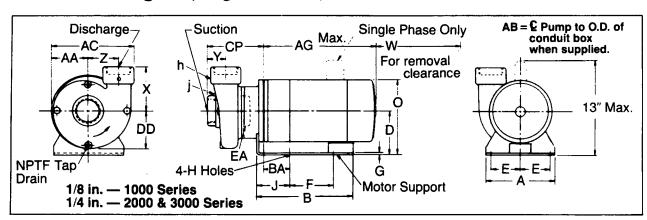
Footnotes: (1) Dimensions are standard NPTF size.

- (2) E.O.S. means end opposite shaft.
- (3) Minimum B10 bearing life calculations based on 25% of the best efficiency point flow. Average bearing life exceeds 9 times published figures.
- (4) 56C standard through 2HP. Contact factory for special 3HP 56C driver.
- (5) Col S pumps capable of 175 psig discharge pressure, 275 psig hydro test.
- (6) Not applicable.
- (7) All dimensions given in inches, weight in pounds.

Type SMP

GENERAL SERVICE

Emensions And Weights (English Units)



Approximate Dimensions—Do not use for construction

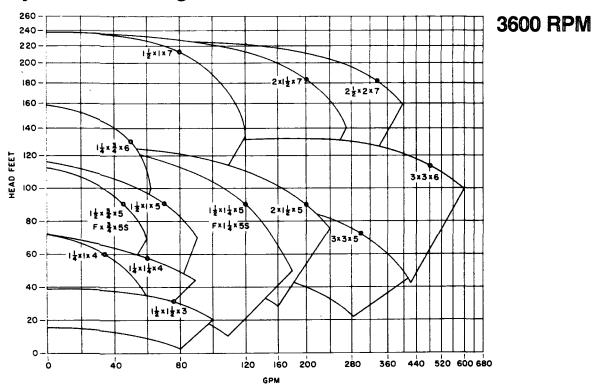
	Pump Dimensions											
Series	Pump	Suction	Discharge	СР	AA	AC	DD	w	x	Υ	Z	Approx. WtLbs.
	1¼×1×4	1¼ NPT	1 NPT	5	3	6%	31/8	2	31/2	11/8	23/4	23
1000	11/4×11/4×4	1¼ NPT	11/4 NPT	5	3	7	31/4	2	31/2	17/8	23/4	25
	1½×1½×3	1½ NPT	1½ NPT	5	3	7	3%	2	31/2	11/8	23/4	25
	11/4×3/4×5	1¼ NPT	3/4 NPT	61/4	31/2	73/8	31/2	3	41/2	21/4	3	35
	11/2×1×5	11/2 NPT	1 NPT	61/4	31/2	73/4	31/2	3	41/2	21/4	31/4	36
2000	11/2×11/4×5	1½ NPT	1¼ NPT	61/2	41/s	8¾	41/6	3	5	21/2	35/8	39
	2×1½×5	2 NPT	1½ NPT	65%	31/8	9	41/2	3	41/2	25%	33/4	43
4	11/4×3/4×6	1¼ NPT	34 NPT	61/4	3¾	8	37/8	3	41/4	21/4	33/8	36
	3×3×5	3 NPT	3 NPT	71/8(1)	41/2	10¾	51/8	4	6%	25/8	4	50
	3×3×6	3 NPT	3 NPT	713/16(1)	5	111/2	51/2	4	6¾s	2%	41/4	55
3000	11/2×1×7	1½ NPT	1 NPT	73/4(1)	5	101/2	5	33/4	43/4	31/8	41/2	55
	2×1½×7	2 NPT	1½ NPT	7¾(1)	5	11	5	3¾	43/4	31/8	41/2	60
	21/2×2×7	21/2 NPT	2 NPT	7¾(1)	5¾	12	51/2	33/4	43/4	31/8	5	65

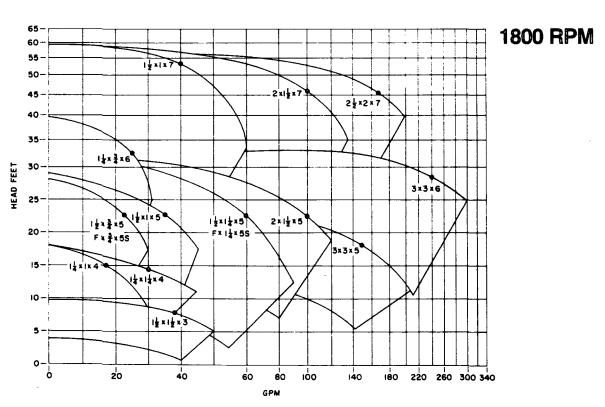
	Maximum NEMA Motor Dimensions												
Frame Size	56C	56C	145TC	182TC	184TC	143JM	145JM	182JM	184JM	213JM	215JM	254JM	256JM
ODP	1/4 to 2	1/4 to 3	3	5	71/2	11/2	2 & 3	5	71/2	10	15	20	
TEFC	1/4 to 2	1/4 to 3	_	3	5 & 71/2	11/2	2	3	5	71/2	10	15	20
A	6	83/4	8¾	113/4	113/4	83/4	8¾	113/4	113⁄4	95∕8	95/6	113/8	113/8
В	67/s	6	6	6 %	65⁄a	6	6	65%	6%	9¾	93/4	91/2	111/4
AG	12	121/8	121/8	157/16	157/16	111/16	111/16	14	14	161/4	175/8	20%16	225/16
D	3.5	5%	5%	5%	5%	5%	5%	5%	5%	5%	55/8	61/4	61/4
E	27/16	4	4	57/16	57/16	4	4	57/16	57/16	41/4	41/4	5	5
F	3	5	5	51/2	51/2	5	5	51/2	51/2	9	9	81/4	10
G	1/e	21/8	21/8	11/8	11/8	21/8	21/8	11/8	11/8	3∕8	3/8	9/16	9/16
Н	11/32	11/32	11/32	13/32	13/32	11/32	11/32	13/32	13/32	13/32	13/32	17/32	17/32
J	3			_		1/2	1/2	9/16	9/16	3/8	3∕8	3/8	3/8
AB	T -	41/2	51/4	57/8	57/8			65/16	65/16	79/16	79/16	815/16	815/16
ВА	29/16	2¾	2¾	31/2	31/2	27/e	2½	35/8	35%	31/2	31/2	5	5
O(2)	6%	9	9	99/16	99/16	7 7/8	87/8	10%	10%	1113/16	1113/16	1215/16(3)	1215/16(3)
Approx. Wt. Lbs.	38	40	45	65	75	3 5	45	80	90	115	150	270	310

Auxiliary Connections (NPTF)							
		1000 Series	2000 and 3000 Series				
ħ	Gage Connection Discharge	1/B	1/4 (4)				
ن_	Gage Connection Suction	1/8	1/4 (4)				
	Mechanical Seal Flush	· 1/8	1/4 (4)				

- Focustes: (1) For 254 & 256 frame add 1" to CP dimension.
 (2) Includes height of motor support when supplied.
 - (2) Includes height of motor support when supplied.
 (3) No motor support supplied on 254 & 256 frame motors.
 (4) Available on 7" pump only.
 (5) All dimensions given in inches, weight in pounds.

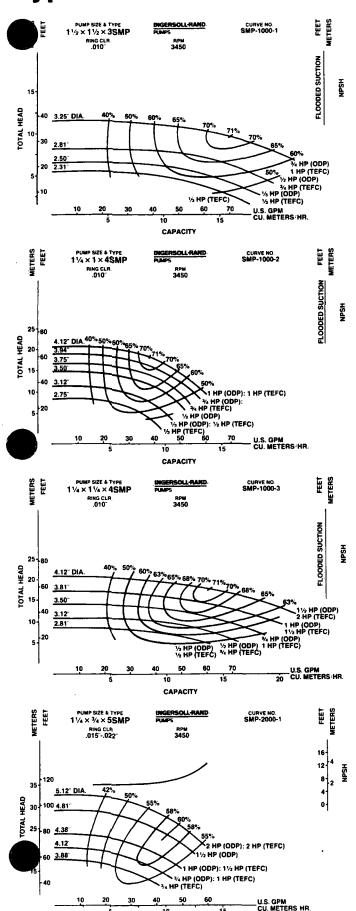
Hydraulic Coverage



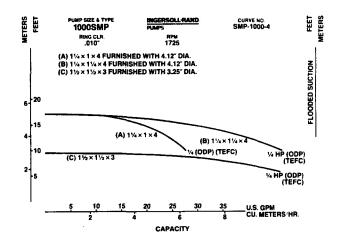


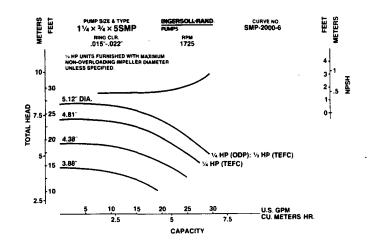
Type SMP

(60 Hertz) Performance Curves



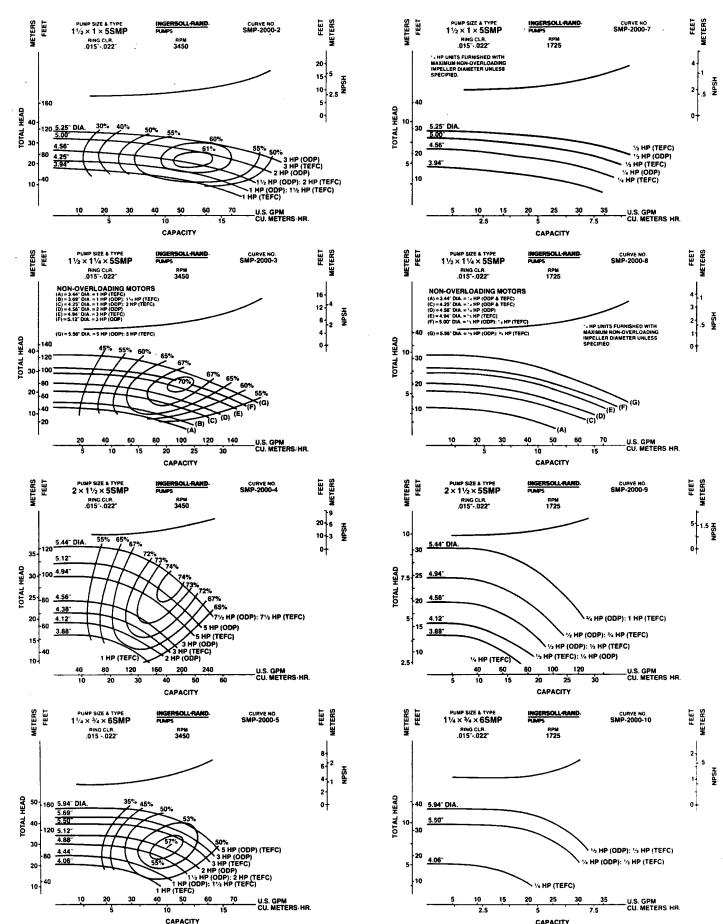
CAPACITY





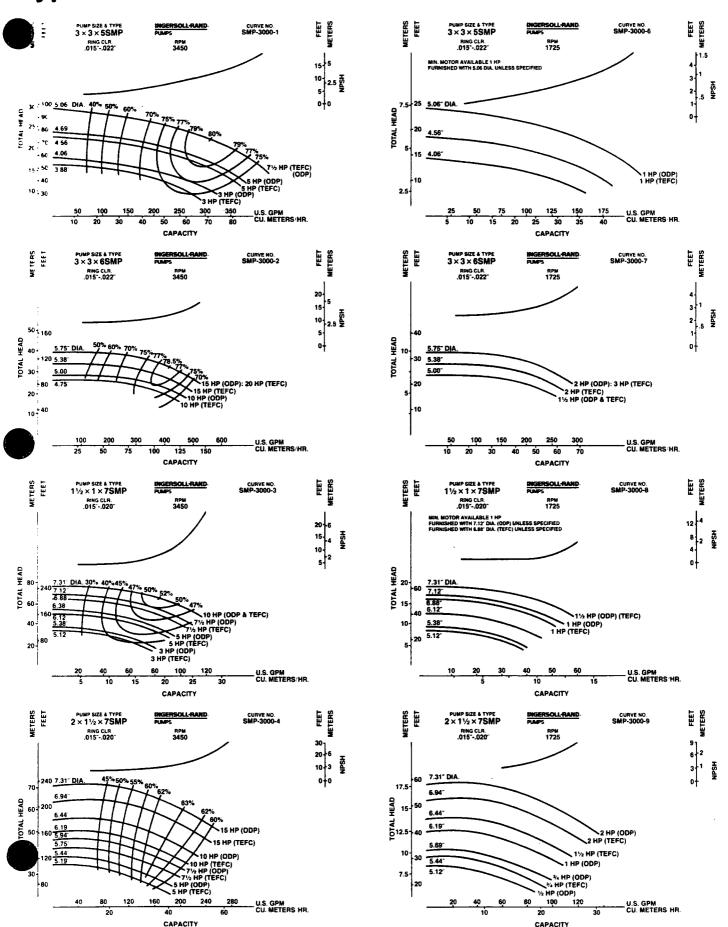
Performance Curves (60 Hertz)

Type SMP

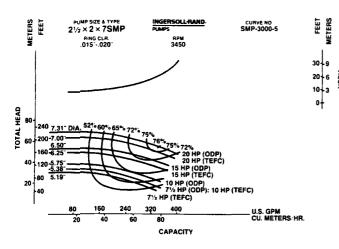


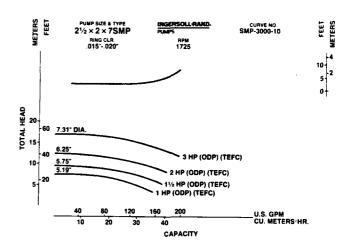
Type SMP =

(60 Hertz) Performance Curves



Performance Curves (60 Hertz) ______ Type SMP

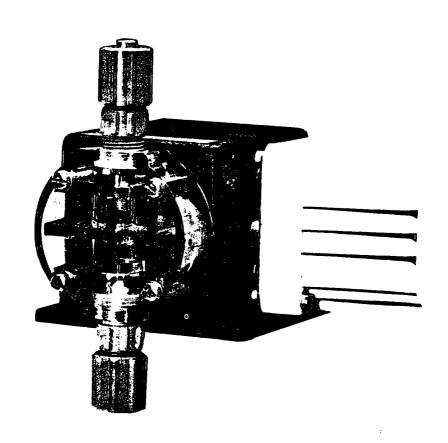




APPENDIX C-6

Nutrient Feed Pump

READ ALL CAUTIONS CAREFULLY BEFORE INSTALLING PUMP SEE PAGE (3)



SERIES 100

INSTRUCTION MANUAL

Code: IMI20 10/91

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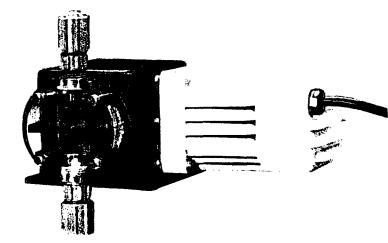
ntroduction	2
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introduction

Series 100

Series 100 are diaphragm-type metering pumps. A fluid is pumped from a chemical storage tank to the point of injection by the pulsing action of the diaphragm. The four check valves (top and bottom of pump head, strainer assembly, and injection assembly) keep the fluid flowing toward the point of discharge.



To insure the solution being pumped can only go forward, it is important that all check valves provide a positive, nonleaking backflow prevention.

The wetted end (those parts that contact the solution being pumped) is constructed of SAN, PVC, teflon, hypalon, and polyethylene. These materials are very resistant to most chemicals. However, there are some chemicals, such as strong acids or organic solvents, which cause deterioration of some elastomer and plastic parts, such as diaphragm, valve seat, or head. Alternate materials such as viton, EPDM, polypropelene, and ryton are available on request.

MANUFACTURER'S PRODUCT WARRANTY

The manufacturer warrants its equipment of its manufacture to be free of defects in material or workmanship. Liability under this policy extends for eighteen (18) months from the date of purchase or one (1) year from date of installation or whichever comes first. The manufacturer's liability is limited to repair or replacement of any device or part which is returned, prepaid, to the factory and which is proven defective upon examination. This warranty does not include installation or repair cost and in no event shall the manufacturer's liability exceed its selling price of such part.

The manufacturer disclaims all liability for damage to its products through improper installation, maintenance, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise, or any unauthorized repair. Replaceable elastomeric parts are expendable and are not covered by any warranty either expressed or implied. The manufacturer is not responsible for consequential or other damages, injuries or expense incurred through use of its products.

The above warranty is in lieu of any other warranty, either expressed or implied. The manufacturer makes no warranty of fitness or merchantability. No agent of ours is authorized to make any warranty other than the above.



Each series 100 chemical feeder has been tested to meet prescribed specifications and certain safety standards. However, a few precautionary notes should be adhered to at all times. THOROUGHLY READ ALL CAUTIONS PRIOR TO INSTALLING METERING PUMP.

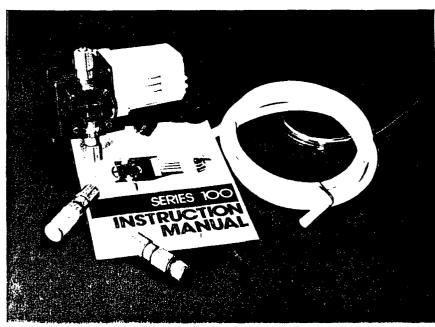
- 1. Protective fitting claps must be removed prior to installing tubing onto fitting assemblies
- 2. Chemicals used may be dangerous and should be used carefully and according to warnings on the label. Follow the directions given with each type of chemical. Do not assume chemicals are the same because they look alike. Always store chemicals in a safe location away from children and others. We cannot be responsible for the misuse of chemicals being fed by the pump.
- Always wear protective clothing (protective gloves and safety glasses) when working on or near chemical metering pumps.
- 4. Tampering with electrical devices can be potentially hazardous. Always place chemicals and feeder installation well out of the reach of children and others.
- 5. Be careful to check that the voltage of the installation matches the voltage indicated on the specification label. Each pump is equipped with a three prong plug. Whether plugging into a receptacle or wiring into a system, always be sure the feeder is grounded. If receptacle is utilized, to disconnect, do not pull wire but grip the plug with finders and pull out.
- 6 Never repair or move the metering pump while operating. Always disconnect electrical current. Before randling the pump always allow sufficient time for the motor housing to cool off. Handling the pump too soon after shutdown may cause hand burns. For safety—use protective gloves.
 - 7. All pumps are pretested with water before shipment. Remove head and dry thoroughly if you are pumping a material that will react with water, (i.e. sulfuric acid). Valve seats, ball checks, gaskets, and diaphragm should also be dried. Before placing feeder into service, extreme care should be taken to follow this procedure.
 - 8. Arrows on the pump head and injection fitting indicate the chemical flow. When properly installed, these arrows should be pointing upward.
 - 9. When metering hazardous material DO NOT use plastic tubing, strictly use proper rigid pipe. Consult supplier for special adapters.
- Pump IS NOT to be used to handle or meter flammable liquids or materials.
- 11. Standard white polyethylene discharge tubing is not recommended for installations exposed to direct sun light. Consult supplier for special black polyethylene tubing.
- 12. Manufacturer will not be held responsible for improper installation of pump, or local plumbing conducted. All cautions are to be read thoroughly prior to hook-up and plumbing. For all installations a professional plumber should be consulted. Always adhere to local plumbing codes and requirements.
- 13. Maximum pressure ratings for series 100 metering pumps is 100PSI. When used with pressurized systems, always be sure the pressure of the system does not exceed maximum pressure rating listed on the specification label.
- Be sure to de-pressurize system prior to hook-up or disconnection of metering pump.

UNPACKING, ASSEMBLING AND MOUNTING:

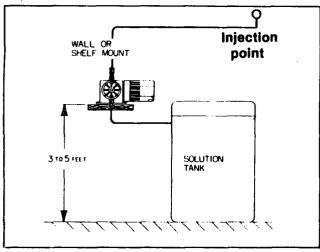
The carton should contain:

- Metering Pump
- 4' Clear Flexible Suction Tubing
- 8' stiff white discharge tubing (Optional Tubing available from the factory)
- Back Check Valve Assembly
- Strainer Assembly
- Instructions
- Anti-Siphon Spring (Figure A)

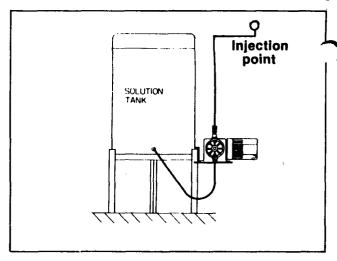
Feeder can be mounted on a wall shelf bracket (Figure B) tank stand platform (Figure C) directly on the wall (Figure D) or directly on the tank cover (Figure E).



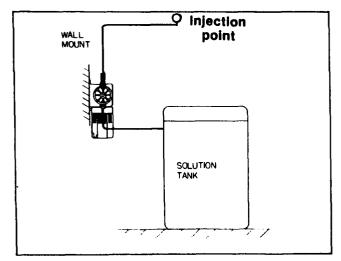
IMPORTANT: Injection point must be higher than top of solution tank to prohibit gravity feeding.



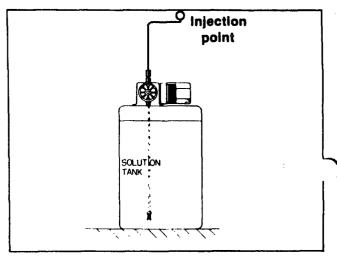
(Fig. B)



(Fig. C)



(Fig. D)



(Fig. E)

To mount the feeder directly on the wall, place the feeder base against the wall with the motor below the pumping head, remove four head mounting bolts, and turn head 1/4 turn so suction is in bottom position. NOTE: Make sure the arrow on the outside of the pump head is pointing upward.

Flooded suction mounting (installing feeder at the base of tank on a platform) is the most trouble free type of installation. (Tank stands and platforms are available for all size feeders and tanks). The Pump is secured on the platform, then the clear suction tubing is attached to a bulkhead fitting assembly and the suction valve housing on the Pump head. Since the suction tubing is always filled with solution, priming is accomplished much more quickly and the chance of losing prime on an installation, where the feeder is used only a few hours a day, is greatly reduced.

Remove protective caps and assemble tubing and fittings to the feeder (Fig. F)

CAUTION: Do not force fittings—Hand Tight Only.

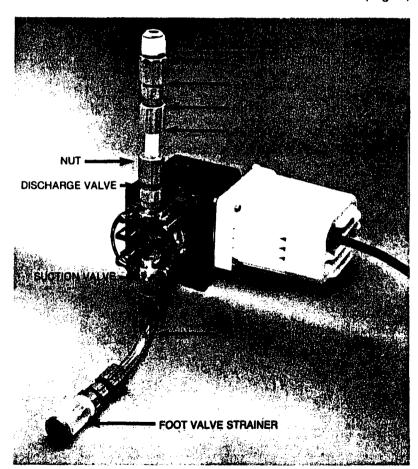
CAUTION: If water is used to dissolve solid chemicals or create a dilute solution, the chemical tanks should be manually filled or an approved means must be used to prevent a cross connection between the chemical tank contents and the potable water line.

CHEMICAL INJECTION:

Chemical Injection into an open tank:
The discharge tubing can be placed in an open tank with or without the injection valve assembly. Each feeder is shipped with an Anti-Siphon spring which should be used in the discharge fitting when pumping into an open reservoir or against atmospheric pressure or when viscous materials are being pumped. This Spring will insure a positive seal on the discharge side of the Pump head.

Pumps carrying NSF seal are listed for swimming pools, spas, and hot tubs.

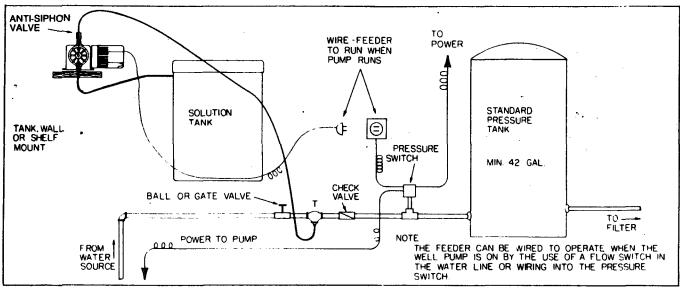
(Fig. F)



INSTALLATION INTO A WELL PUMP SYSTEM:

Make sure the voltage of the feeder matches the voltage of the well pump. Install the injection fitting into a tee which is installed into

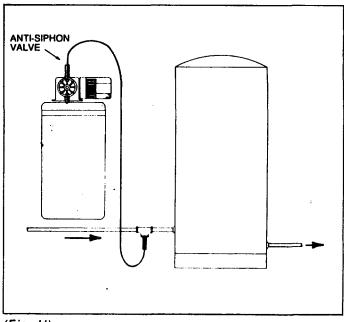
the water line going to the pressure tank. The end of the injection check valve should be in the main stream of the water line. A typical installation is shown in Figure G. **NOTE: Be sure to install the injection assembly in a vertical position on the bottom side of the water line** (Figure H). This will insure proper sealing of the injection assembly check valve and prevent a back flow into the feeder's discharge line. Be sure arrow on injection fitting is pointing upward.



(Fig. G)

DOWN-THE-WELL INSTALLATION:

Often it is desirable to provide chemical feed near the intake of the pump for additional retention time and mixing of the chemicals. An additional length of discharge tubing will be required for this installation. Tape the end of the discharge tubing to the pump cylinder, drop pipe, or foot valve and lower it into the well. An Anti-Siphon Valve must be installed on systems such as this where the discharge is lower than the feeder and the chemical storage tank. Failure to install Anti-Siphon valve will cause siphoning to occur.



(Fig. H)

ANTI-SIPHON VALVE:

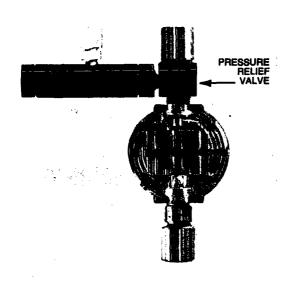
Under any installation condition where the possibility of siphoning or suction may occur, install the Anti-Siphon Valve on the discharge side of the feeder (Figure I), replacing the discharge valve housing. Be careful when removing or disassembling the discharge valve assembly that small parts, such as ball check and gaskets, are not lost. The Anti-Siphon valve is not part of the standard package. This item can be furnished by your dealer at extra cost.



PRESSURE RELIEF VALVE:

All Series 100 chemical pumps are rated to pump against line pressure of 100 P.S.I. If the line pressure on an installation could fluctuate above 100 P.S.I. install a pressure relief valve on the discharge side of the pump head (Figure J) replacing the discharge valve housing. Once the pressure reaches a certain level, the pre-set relief valve will return the solution being pumped back to the solution tank. This will prevent motor burnout or diaphragm rupture. The Anti-Siphon Valve and the pressure Relief Valve can also be used at the same time for special applications (Figure K). The relief valve is not part of the standard package. This item can be furnished by your dealer at extra cost. Read relief valve instructions carefully before installing.





(Fig. K)

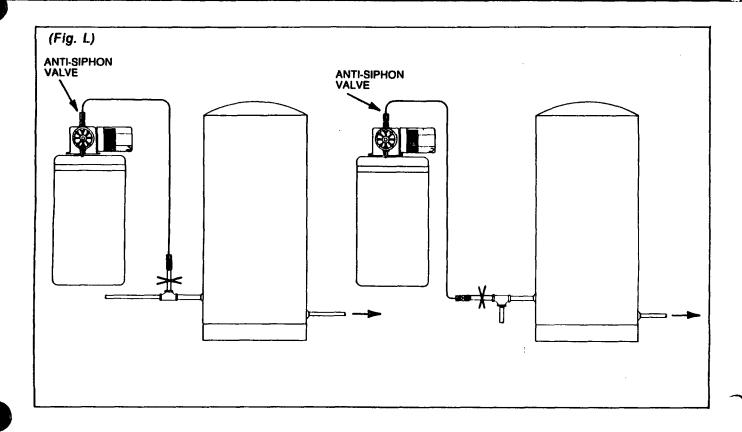


POINT OF INJECTION:

Pipe corrosion can result if dilution at the injection point does not occur rapidly. This problem is easily prevented by observing this simple rule: install injection fitting so that the end is in the flow stream of the line being treated. NOTE: Extended injection assemblies are available for large water lines. Consult your dealer.

COMMON ERRORS IN THE INJECTION OF CHEMICALS:

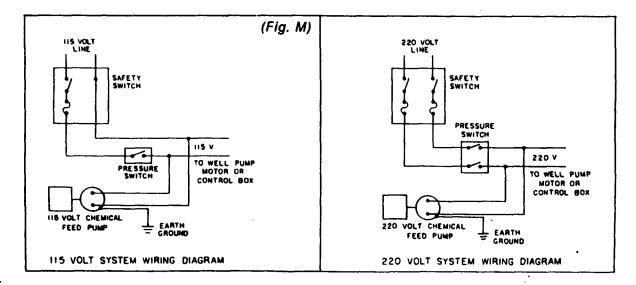
Do not insert the injection fitting into a pipe stub in the tee. A full strength solution will often cause corrosion or scale in the pipe stub when it is not in the following stream (Figure L). The maximum lift of the chemical feeder is five feet. Be sure not to exceed this height. It is very important that arrow on injection fitting and head point straight upward in order to prevent backflow. Arrow indicates the proper flow of the chemicals.



start-up

POWER:

The standard chemical feeder is available in 115 volt 60 cycle single phase. 230 volt 60 cycle and 230 volt 50 cycle single phase can also be made available upon request. **CAUTION: Be sure the voltage of the feeder matches the power supply** (Figure M).



start-up

PRIMING:

CAUTION: All pumps are tested with water. If the chemical to be pumped reacts when mixed with water (i.e. sulfuric acid) the pump head should be removed and dried thoroughly along with the diaphragm and valve seats.

The outlet tubing should be temporarily disconnected during the priming of the pump if it is connected directly to a pressurized water line. Turn on the power to the pump, loosen the locking lever by turning it counter-clockwise and turn the output adjusting knob counter-clockwise to full capacity, (one full turn only) then tighten the locking lever by turning clockwise to a hand tight position. Chemical should be pumped to the head within a few minutes.

NOTE: The feeder is adjustable while running, never force the dial. If the chemical hasn't reached the head in a few minutes, remove the discharge fitting and dampen the discharge valve area (ball check and valve seats) with a few drops of solution being fed by the pump. For safety, use protective gloves and safety glasses and a proper container to hold chemical.

Once the pump has been primed and is pumping the chemical through the head, turn off the power, reconnect the discharge and immediately clean any excess chemical left on the housing or pump head.

Turn the power on once more and adjust the pump to the proper rate, using the locking lever as before.

NOTE: To prime pump without temporarily disconnecting the outlet tubing, the pump can be supplied with a bleed valve/return line. Consult supplier for details.

CAUTION: When working on or around a metering pump installation, protective gloves and safety glasses should be worn at all times.

Check calibration of the pump before leaving the installation site. A test for chemical residual in the treated water is the best indication of the correct pump setting.

maintenance

SCALE: GASKETS AND CHECK VALVES

When checking the metering pump or providing a routine maintenance, replace all valve seats or ball checks if any of them show any wear or deterioration. (Valve seats should be checked approximately every 4-6 months depending upon the application.) Repeated deterioration of valve seats and other rubber or plastic parts within a few months period usually indicates another material must be used for the defective part. Contact your supplier or see the parts list for parts made of viton, EPDM, ryton, teflon or polypropelene.

maintenance

OUTSIDE INSTALLATION:

In many areas where freezing conditions are not a problem it is common to install a metering pump outside. Adequate protection should be provided to keep the pump from being exposed to direct sunlight or rain. Any simple covering adequately ventilated will afford the necessary protection from weather. NOTE: When discharge tubing is exposed to direct sunlight, black polyethylene tubing should be used in lieu of the stiff white translucent tubing supplied with each pump.

SOLUTION TANK:

Check the solution tank for settling of chemicals. If there is sludge on the bottom of the solution tank, clean the strainer, the foot valve, and the solution tank. Installing the foot valve a few inches above the bottom of the tank will prevent future clogging. NOTE: If the chemical being pumped regularly precipitates out of solution or does not dissolve easily or completely (calcium hydroxide), mixers are readily available in different motor configurations and mountings.

OUTPUT ADJUSTING KNOB:

Sometimes the output adjusting knob can move on its shaft and cause a false output indication. This can happen if the knob set-screw slips or if the unit is disassembled for any reason. The unit can be reset to "0" as follows:

- 1. Remove the dial stop.
- 2. With the pump running, loosen the locking lever and turn the adjusting knob counterclockwise until it is "loose" to touch.
- 3. SLOWLY rescrew the knob clockwise, using very light finger pressure. It will soon start to advance in pulses as the internal cam comes in and out of contact.
- 4. When light finger pressure will no longer allow movement of the knob between cam contacts, grasp the knob securely and tighten the locking lever (turning clockwise) making sure that the knob does not move. To check for zero point, turn on pump. There should be no liquid coming out of discharge fitting.
- 5. Replace dial stop.
- 6. If the pointer is not at "0", loosen the set-screw on the knob (use a 5/64" Allen key), and turn pointer to "0", then retighten the set-screw while holding the knob in place.
- 7. A setting of "0" will now give zero output. One full revolution of the knob counter-clockwise will give maximum output. The knob should never be turned more than one full revolution.

servicing & repairs

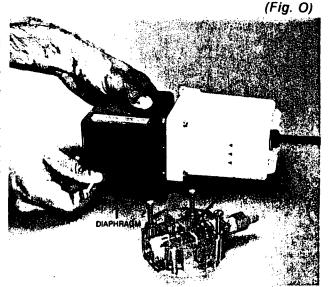
REPLACEMENT OF PUMP HEAD ASSEMBLY OR DIAPHRAGM:

CAUTION: Before performing any repairs on series 100 chemical feeders, be sure to disconnect all electrical connections and make sure all pressure valves are off. The series 100 feeder was designed so that servicing can be quick and simple. Proper part replacement procedures are described below: NOTE: Use protective gloves and safety glasses when working on or around chemical feeder.

- Disconnect the discharge tubing. Remove the suction valve and discharge valve being careful not to lose the ball checks and any other small parts.
 (Figure N).
- 2. Remove the four screws from the face of the head and remove the head.
- 3. Remove the diaphragm by inserting one or two of the head bolts into the holes of the diaphragm and turning counterclockwise (Figure 0).
- 4. A new pump head or diaphragm should be installed if either is broken or cracked (see parts list at the end of this manual). The new pump head can be installed by going through the above steps in reverse.
- DISCHARGE VALVE
 BALL CHECK
 SUCTION VALVE
 DISCHARGE TUBING

(Fig. N)

- 5. Be sure the diaphragm shaft is in the **full in position** when installing the new diaphragm. Install the new diaphragm by screwing it in hand tight, then, back off one-fourth turn or until screw holes are lined up.
- Replace the head and the head screws, being certain the discharge fitting is up. NOTE: Arrow on outside of pump head should be in vertical position pointing upward. Tighten the head screws evenly and carefully to prevent cracking the head.
- Replace the suction and discharge fitting making sure all gaskets and valves are fitted properly. HAND TIGHTEN ON-LY. Restart the system as in the START UP procedures.



BALL CHECKS AND VALVE SEAT REPLACEMENT:

The following procedure is the same for any of the four valves. CAUTION: Make sure all electrical connections are disconnected and pressure valves off.

NOTE: Use protective gloves and safety glasses while replacing parts.

- 1. Unscrew compression fitting and remove tubing.
- 2. Unscrew check valve body from pump head, foot valve, or injection fitting.
- 3. Remove all seats, ball checks, and gaskets and replace.

servicing & repairs

- 4. Replace the check valve body so that either fitting makes contact with the gasket and pump head, foot valve injection fitting, whichever the case may be. HAND TIGHTEN FITTINGS ONLY.
- 5. Re-install the tubing and tighten coupling nut HAND TIGHT.
- 6. Restart the system as in the START UP procedures.

trouble shooting

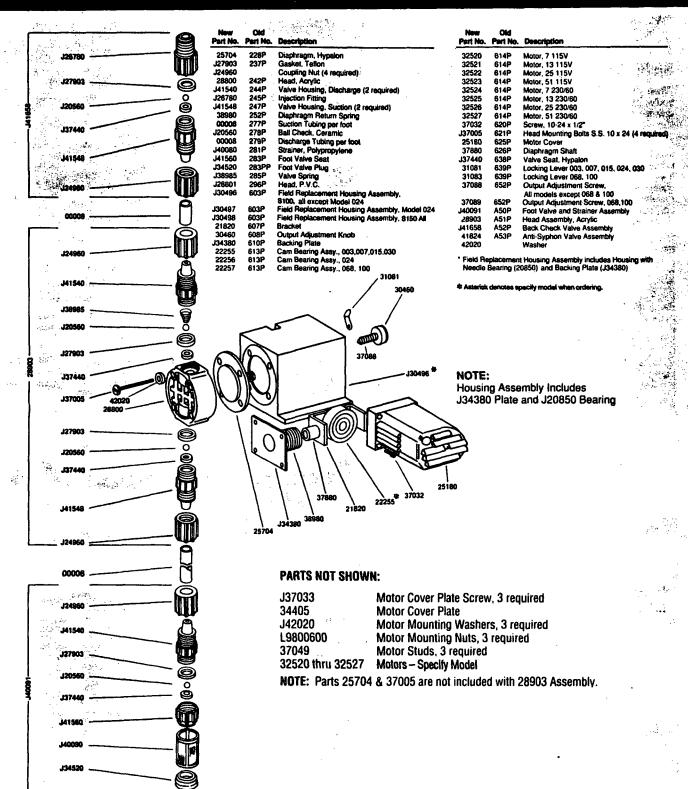
PROBLEM	PROBABLE CAUSE	REMEDY
LOSS OF	1. Feeder setting too low	Adjust to higher setting (Feeder must be operating during the adjustment).
CHEMICAL RESIDUAL	2. Scale at injection point	Clean injection parts with 8% muriatic acid or undiluted vinegar. See Maintenance Section.
	3. Solution container allowed to run dry	Refill the tank with solution and prime. See Start Up Section.
	1. Feeder setting too high	Lower feeder setting (feeder must be operating to adjust the dial).
TOO MUCH CHEMICAL	Chemical in solution tank too rich	Dilute chemical solution. NOTE: For chemical that reacts with water, it may be necessary to purchase a more dilute grade of chemical direct from chemical supplier.
	3. Siphoning of chemical into well or main line	Test for suction or vacuum at the injection point. If suction exits, install an anti-siphon valve. See figure
LEAKAGE AROUND TUBING CONNECTIONS	1. Worn tube ends	Cut off end of tubing (about 1") and then slip on as before or replace suction valve housing with compression fitting to prevent slippage.
COMMESTICATION	2. Chemical attack	Consult your distributor for alternate material.
FAILURE TO PUMP	Leak in suction side of pump	Examine suction tubing. If worn at the end, cut approximately an inch off at end and replace or replace slip on fittings with compression fittings.
OR FEED	2. Valve seats not sealing	Clean valve seats if dirty or replace proper material if deterioration is noted.

trouble shooting

PROBLEM	PROBABLE CAUSE	REMEDY
	3. Low setting on feeder	When pumping against pressure, the dials should be set above 40% maximum rated capacity for a reliable feed rate.
	4. Low solution level	4. Solution must be above foot valve.
FAILURE TO PUMP	5. Diaphragm ruptured	5. Replace diaphragm as shown in the "Service" Section. Check for pressure above 100 PSI at the injection point. NOTE: Chemical incompatibility with diaphragm material can cause diaphragm rupture and leakage around the pump head.
ONFEED	6. Pump head cracked or broken	6. Replace pump head as shown in Service Section. Make sure fittings are hand tight only. Using pliers or wrench on fittings can crack pump head. Also, chemical incompatibility can cause cracking and subsequent leakage.
	7. Pump head contains air or chlorine gas	 After turning off all pressure lines, disconnect discharge tubing and discharge valve housing. Consult sup- plier on installation of bleed valve.
	1. Dirty check valve	Remove and replace or clean off any scale or sediment.
UNIT LOSES PRIME	Ball checks not seating or not sealing properly	 Check seat and ball checks for chips; clean gently. If deformity or deteriora- tion is noted, replace part with proper material. Resulting crystals can hold check valves open; therefore the valves must be disassembled and cleaned. Be sure to replace all parts as shown in the Parts Diagram (at the end of the manual).
	Solution container allowed to run dry	3. Refill container with proper chemical.
	1. Loose fittings	All fittings can be hand tightened to prevent leakage. Clean off chemicals which have spilled on feeder.
FITTING LEAKAGE	Broken or twisted gasket	2. Check gaskets and replace if broken or damaged.
	3. Chemical attack	Consult your distributor for alternate material.

trouble shooting

PROBLEM	PROBABLE CAUSE	REMEDY
FEEDER WILL NOT PRIME	Too much pressure at discharge 2. Check valves not sealing	 Turn off all pressure valves, loosen outlet tubing connection at discharge point. Remove discharge valve housing. Dampen ball check and valve seats with a few drops of solution. Set feeder dial to maximum rate and turn on feeder. When feeder is primed, reconnect all tubing connections. Disassemble, loosen, clean, and check for deterioration or swelling. Reassemble and wet the valve assembly, then prime. See Start-Up Section.
	Output dial not set at maximum	Always prime pump with output dial set at maximum rated capacity.
ANTI-SIPHON VALVE	Scale or particles have plugged diaphragm	Remove, clean and reassemble, being careful not to wrinkle the diaphragm. Check sequence and position of parts to be sure reassembly is correct.
MALFUNCTIONS	2 Ruptured valves	Consult your distributor for replacement.
PUMP MOTOR	Pumping against excessive pressure	Test pressure to determine if it exceeds feeder specifications. If so, consult your distributor.
STALLS	2. Low voltage to feeder	Make sure voltage of power source matches the voltage on the feeder specifications label, if not, transformers are available.
MOTOR RUNNING VERY HOT	Low voltage If using a stepdown	Power supply voltage should match voltage on feeder specification label. Check the transformer to be sure it
V seril 110	transformer, it may be undersized for the feeder	has at least 100 watts capacity.



3

*

Keep-On-Pumping kits that can save you time and money

SAVE TIME!

When you need a part, you've got it! You can cut downtime and production loss from days to minutes.

A KOPkit is a troubleshooter's best friend. If the event of a breakdown. It will put you back in business fast! Preventive: maintenance will ensure continuous high performance of your pump.

SAVE MONEY!

You also save by buying parts in KOPkit form compared with buying individual parts.

Each KOPkit part is vacuum sealed to keep it clean and dirt free even when stored for long periods of time.



A typical KOPkit includes Pump Head assembly with Valve, Diaphragm, Head Screws, Washers and an exploded view assembly crawing.

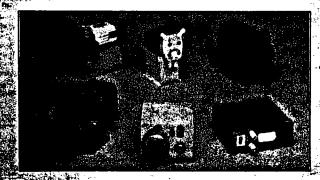
FOR PERISTALTIC PUMPS:

A typical KOPklt includes Pump Head assembly with Tube, Retaining Clamps, Hose Clamps and an exploded view assembly drawing.

A STATE OF THE STA HOW TO ORDER THE RIGHT KOPKI FOR YOUR PUMP

Simply prefix the pump's model/part number with letter "K".

Keep on pumping! Get all the money-saving and security benefits of KOPkits immediately.

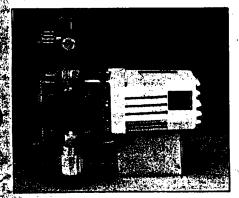


Bleed Valve Kits

Bleed Valves are now available for the Series 100, 100D, 150, 150D, and 200 chemical metering pumps.

THE SWART WAY TO AID PRIMING OR RELIEVE LINE PRESSURE

These high quality Bleed Valves evacuate entrapped air or vapors from the pump head to aid in priming. They also provide a safer way to drain liquid and relieve pressure from the discharge line.



IT'S A COMPLETE KIT

Designed to retrofit your chemical metering pump, each Bleed Valve Kit. includes a Bleed Valve Assembly, Discharge Valve, gasket, 4' of 3/8" Ribing, and Installation-Operation Instructions. Kits are packaged in clear bags to stay clean even when stored for long periods of time. 36

ORDER BLEED VALVES WHEN ORDERING PUMPS

To order Bleed Valve Kits complete with pump, request the suffix code (-057) to be added to the pump's part number. A variety of materials are available to suit your specific application.

series 100, 1000, 150,



White Wall State S Company of the sales

CF	ider bleed valve kits to	RETRO-FIT EXISTING PUMPS
PART NO.	MATERIAL TUBING EXTERIOR/OFTERIOR SEZE	MATERIAL TUBBO NO. EXTERIOR/BITERIOR SEZE
.30507 .30508 .30508	PVC HYP 36 PVC EP6 36 PVC VTN 36	JS055 PAC HMP 50 JS0510 PAC BP8 50 JS0517 PAC VTN 50
J30510 J30511 J30512	PVC - TFE 26 FFP - W/P 23 FFP 5F8 20	.00518 PAC THE 50 .00519 PRP 107P 50 .00600 PRP PRB 50
27000. 27000. 27000.	FFP VTN 30	.0082 FFF VIN 50

APPENDIX C-7

Level Switches



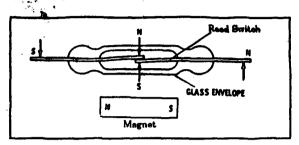
Gems Sensors Division Imo Industries Inc. One Cowles Road Plainville, CT. 06062-1198

TEL: 203-747-3000 FAX: 203-747-4244

CAUTION! Read This Before Installing Unit!

Failure to use this unit within the proper current capacity will result in faulty operation!

The "heart" of all GEMS level and flow switches is a hermetically sealed, magnetic reed switch within the unit stem: If used within its current carrying capacity, the reed switch will last through hundreds of millions of cycles.



DON'T COOK YOUR REED SWITCH!!!!

Check the current capacity shows on the label of the unit you have purchased, to be sure you are within proper ratings! (See "Switch Ratings - Max. Resistive Load" chart on reverse of this sheet.)

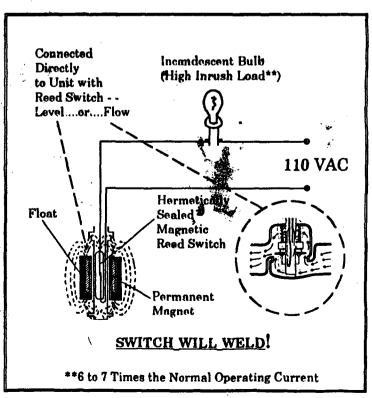
Don't Be Misled:

.... By the resistive ratings of the switches. Most applications involve inductive or capacitive loads.

If the reed switch is hooked up directly to the load, it will likely weld the contacts or erode the contact surface; thereby, shortening switch life.

.... By the wattage ratings of loads. Low wattage loads are often high inductive devices, making contact protection very important**.

**See reverse side of this sheet for information on contact protection required when switching inductive loads such as relays, solenoids, motor starters and transformers. Ask about our solid-state relays for loads of 5 - 10 amps. Consult your local electrical engineer or GEMS, if in doubt.

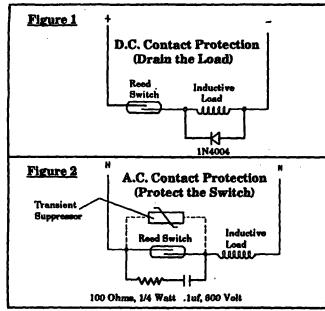


Switch Ratings - Max. Resistive Load

VA	Volts	Amps AC	Amps DC
	0-50	.2	.13
10	120	.08	.05
	240	.04	02
	0-50	.3	2
15	120	.12	.08
	240	.06	.04
	0-30	.4	.3
20	120	.17	.13
	240	.08	.06
	0-50	0.5	0.5
50*	120	.4	.4
	240	.2	.2
100*	120	.8**	N.A.
100*	240	.4	N.A.

^{*}Level switch units with 50 VA or 100 VA switches are not UL-recognized.

^{**}Limited to 50,000 operations.



Note: Max. Leakage Current: 4ma @ 120 VAC

Standard reed switches in GEMS level and flow switch units are hermetically scaled, magnetically actuated, make-and-break type. Switches are SPST or SPDT in various ratings, depending on unit model.

Switch Ratings of UL-Listed Units: 10 VA or 20 VA at 120 through 240 VAC, pilot duty. Gems Sensors Division would be pleased to run life tests on our units with your specific load and issue a report indicating the approximate number of cycles that can be expected.

Contact Protection Requirements

When switching inductive loads such as relays, solenoids and transformers, reed switch contacts require protection in order to insure long, dependable life. When current is interrupted, the inductance or electrical inertia of the load generates a large high frequency voltage, which appears across the switch contacts. If the voltage is large enough, it can break down the medium in the gap between them, making a conductive path. This phenomenon, called "arcing", is the spark you see. Arcing can cause the contacts to burn, weld together or stick; thus, giving unreliable performance. The purpose of protection circuits is to prevent arcing, by shorting this voltage through an alternate path.

Recommended Protection (D.C.)

A 1N4004 diode (or equivalent) connected cathode-topositive, as shown in Figure 1, is recommended. The diode does not conduct when the load is energized, but conducts and shorts out the generated voltage when the switch opens. The generated voltage always acts in series with the applied voltage.

(A.C.)

A resistor and capacitor, connected in parallel with the switch, as shown in Figure 2, is recommended. The capacitor is a high impedance to 60 hertz, but is essentially a short circuit to high frequencies of generated voltages.

Switch Transient Protection Assembly RC Network - P/N 134580	\$4.70 Ea.
Switch Contact Protection Kit P/N 134579 Includes: Diode, Varistor, RC Network	\$7.31 Ea.
Varistor - P/N 59690	\$2.78 Ea.

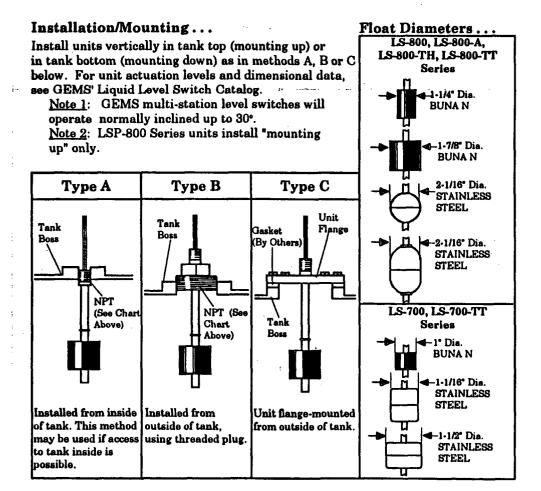
Transient suppressors or varistors may also be used to dissipate the transient and protect the switch contacts. (See Fig. 2) For 130 VAC rated devices, the following table may be used for selection.

		Maximun	Ratings (25 °	Characteristics							
	Continuous		Trans	Transient		17					
Model Number	RMS Voltage	DC Voltage	Energy	Peak Current (8 x 20us)	Vnom Varistor Peak Voltage		Max. Clamping VoltageV。途 Test Current (8 X 20us)		Typical Capacitance	Model Size	
	V	V _{dem}	W _{tm}	I _{tes}	Min.	Max. 🧐 I mA de	Max. @ I mA ac		lp	f=0.1-1 MHz	(mm)
	Volts	Volts	Joules	Amperes	Volta	Volts	Volts	Volts	Amps	Picofarads	
V130LA1			4	500		255	273	390	10	180	7
V130LA2		i i	8	1000		232	254	340	10	180	7
V130LA10A	130	175	30	4000	184	232	254	340	50	1000	14
V130LA20A	ł	1 1	50	6000		232	254	340	100	1900	20
V130LA20B	L	[]	50	6000		220	238	325	100	1900	20

133702

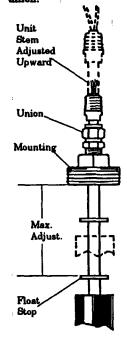
General Electric Model Numbers are shown for reference only.

GEMS °	Series	Туре	Mtg., Plug (or Flange) Size	Wrench Hex. (or Flats) Size 7/8"	Mtg. Method	Float Dia.
Instruction Bulletin	LS-800 LS-800-A	2	1-1/4" NPT	1"	В	See
No. 72978		3	2" NPT	1-1/4"	B	Chart
	LS-800-TH LS-800-TT	4	3", 150# Flange	7-1/2" Dia.	C	Below
Multi-Station	LS-700 LS-700-TH LS-700-TT	1 2	1/8" NPT	1/2"	A B	
		3	3/4" NPT	1-1/16"	В	See
Level Switches		 }-	1" NPT	1-5/16"	C	Chart
			3-5/8" Dia. Flange	3-5/8" Dia.	C	Below
INSTALLATION AND	LSP-800 Plastio	A	1" NPT	1-3/8" PVC 1-3/16" PP or PVDF	A	3"
AND		В	3" NPT	3-3/8"	В	٠
MAINTENANCE		С	3" - 150# Flange	7-1/2" Dia.	C	



LS-800-A Series Units Vertical Adjustment . . .

Loosen union atop unit and slide stem up or down as desired. Re-tighten union.



Electrical Connection . . .

Connect unit lead wires as in "Wiring Color Chart" and "Wiring Diagrams" below. L1 is the lowest level when unit is installed "mounting up and the highest level when unit is installed "mounting down". Most units include a 1/2" NPT for conduit connection.

Wiring Color Chart...

SPST Switches					SPDT Switches			
	Group 1	Group II Grou			up III Group IV			
Wire Size	Note 2			te 2	Note 2			
Unit Com.	Black	None		BI	ack	None		
	NOMC	SW Com.	NOMC	ИО	NC	SW Com.	NO	NC
Li		400	44 TW	1	Will's	PY	THE A	MARINE
L2	Valle		Pellog		MILL		AMA	MARINA
L3		11.4		Blue	Wh/Blue	~		Wh/Blk/Blu
1.4	Bress	Brown	Brown	Brown	Wh/Brn	Brown	Wh/Brn	Wh/Blk/Brn
L5	9	Orange	Orange	Orange				Wh/Blk/Orn
L6	Gray	Gray	Gray	Gray	Wh/Gra	Gray	Wh/Gra	Wh/Blk/Gra

Note 1: LS-800 units in shaded areas can be supplied in UL-recognized configurations.

Note 2: Wire size is #18 AWG for UL-recognized units and #22 AWG (Teflon) for non-UL-recognized units.

Typical Wiring Diagrams . .

Group III Group IV Group I Group II SPST

Two actuation levels are shown in each group diagram. Switches are shown in normal (dry) position. Level Switch

> LS-800-TH Only: Thermostat may be specified NO or NC. Level switch stations are connected as in the "Wiring Color Chart*.

Green Temperature Switch

Maintenance.

An occasional "wipe-down" cleaning is the only maintenance normally required. DO NOT DISASSEMBLE UNIT. Return unit to Gems Sensors Division for any service required.

WARNING

Product must be maintained and installed in strict so dance with the Gema technical brochure and instruction bulletin. Failure to observe this warning could result in serious injuries or damages. For hazardous area applications involving such things as (but not limited to) ignitable mixtures, combustible dust and flammables, use an appropriate explosion-proof enclosure or intrinsically safe interface device.

sure and temperature limitations shown on the individual catalog pages and drawings for the specified flow switches must not be exceeded. These pressures and temperatures must take into consideration possible system surge pres-

sures, temperatures and their frequencies.

The liquids used must be compatible with the materials of construction. Specifications of materials will be given upon request. Life expectancy of switch contacts varies with applications. Contact the Factory if life cycle testing is required.

Ambient temperature changes do affect switch set points, since specific gravities of liquids vary with temperature. Con-

sult Factory for assistance.

Level switches have been designed to be shock and vibration resistant; however, shock and vibration should be minimized. Consult Factory for assistance

Excessive contaminants in fluid may inhibit float operation and occasional wipe-down may be necessary. Consult Factory for assistance.

Troubleshooting and maintenance of level switches should be in strict compliance with procedures set forth in the troubleshooting and maintenance sections of the technical brochure or an instruction bulletin.

Electrical entries and mounting points require liquid/vapor ealing.

Level switches must not be field-repaired. Physical damage to product may render product unserviceable.

Imo Industries Inc.

Gems Sensors Division 1 Cowles Road

Plainville, CT. 06062 TEL: 203-747-3000 FAX: 203-747-4244

P/N 72978 (Rev. D)





PROCEDURE FOR SETTING COLLARS OR SNAP RINGS ON MULTI-LEVEL SWIICHES

- 1. Slide float up towards mounting plug until switch just transfers (opens or closes).
- 2. Set upper stop at 1/8" to 3/16" from upper surface of float.
- Slide float down until switch just transfers (opens or closes).
- 4. Set lower clip at 1/8" to 3/16" from lower surface of float.

It is imperative that the proper float overtravel be set. If set lower than 1/16 of an inch, the level switch will not work reliable under higher temperatures. If set greater than 3/16 of an inch, the switch may double actuate (close/open/close again).

If you have any questions regarding this procedure or need assistance, please contact the nearest IMO representative.

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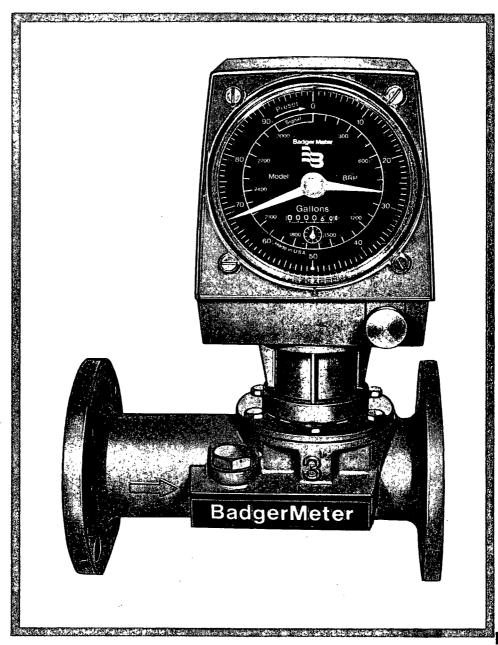
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APPENDIX C-8 Effluent Flow Totalizer

Sizes 2" through 6"

Industrial Turbo Meters

Installation & Operation Manual



FLOW MEDIA, INC. P.O. Box 401 Carnegie, PA 15106 (412) 276-8055



Badger Meter, Inc. Industrial Division

4545 W. Brown Deer Road, P.O. Box 23099, Milwaukee, WI 53223-0099

SCOPE OF THE MANUAL

This manual contains information concerning the installation, operation and maintenance of Badger magnetic drive turbo meters. To ensure efficient operation of the meters, the instructions given in this manual should be thoroughly read and understood. Retain the manual in a location where it is readily available for reference.

Maximum Operating Temperature	250° F (120° C)	
Maximum Operating Pressure	150 PSI (10 Bar) (Optional 300 PSI (Bronze),	
	250 PSI (Cast Iron))	
Accuracy Over Entire Range *	± 1.5%	
Repeatability	0.5% or Better	
Connections	Round Flange ASA or DIN	
Body Materials		
Rotor and Nose Cone Materials	Ryton	
Head Assembly Materials	SS 316 or Bronze	
Straightening Vanes Material	SS 316	
	Asbestos, Nitrile or Chloroprene	
"O" Ring Materials		
Bearing and Magnet Material		
Spindle	SS 316	

INSTALLATION

UNPACKING AND INSPECTION

To avoid damage in transit, Badger turbo meters are shipped to the customer in special shipping containers. Upon receipt of the order, perform the following unpacking and inspection procedures:

NOTE: If damage to a shipping container is evident upon receipt of a meter, request the carrier to be present when the meter is unpacked.

Retain the container and all packing material for possible use in reshipment or storage. Visually inspect the meter and applicable accessory device for any physical damage. If damage is found, notify carrier for insurance purposes.

INSTALLATION

The procedures for installing Badger turbo meters are essentially the same for all meter sizes. Any special instructions required for the installation and/or electrical connection of meter-mounted or free-standing accessory devices such as registers, pulse transmitters, valves and remote batch controllers will be provided as a supplement to this manual.

a. PRELIMINARY CONSIDERATIONS

- Badger's 2" through 6" industrial turbo meters are designed for operation in HORIZONTAL piping arrangements.
- 2. If solid material is present in the liquid to be metered, a strainer may be required in the facility piping upstream of

the meter. The 2", 3" and 4" meters require a strainer with 1/16" diameter holes and the 6" meter requires a strainer with 1/8" diameter holes.

3. To permit periodic cleanout of the meter and to provide a convenient means of stopping fluid flow during maintenance, it is recommended that a flushing system be incorporated into the facility piping arrangement.

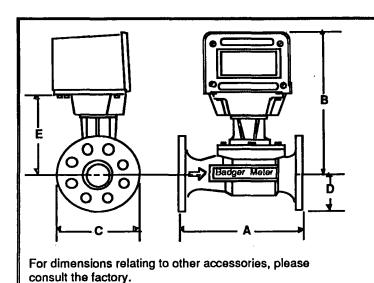
b. INSTALLING THE METER

- 1. Install the meter in the pipeline making sure that the flow arrow on the meter housing is in proper relation to the direction of liquid flow.
- 2. Install and tighten the flange connection bolts.
- 3. To relieve possible strain on the piping due to the weight of 4" and 6" turbo meters, it is recommended that consideration be given to installation of a meter support under the meter housing.

PERFORMANCE

Complete the following checks to ensure that the meter is properly installed and operational.

- a. Slowly open the upstream valve to apply liquid pressure to the meter and check the flange connections for possible leaks. Retighten the flange bolts as required.
- b. Perform a functional test of the turbo meter using the adjustment and calibration procedure in this manual.



	2"	3"	4"	6"
Α	10.00	12.00	14.00	18.00
В	13.67	13.67	15.34	16.84
C-150#	6.00	7.50	9.00	11.00
C-300#	6.50	8.25	10.00	12.50
D-150#	2.75	3.50	4.25	5.25
D-300#	3.00	3.87	4.75	6.00
E	6.86	6.86	8.53	10.03
Est. Wgt Per Unit in (Lbs)	30-40	40-50	60-75	100-125

All dimensions in inches.

OPERATION

GENERAL OPERATING INSTRUCTIONS

CAUTION: Regardless of the operating procedure used, the valves or devices controlling the flow of liquid through the turbo meter must always be opened and closed slowly or in stages to prevent shock loads that may damage the meter's rotor assembly.

a. MANUAL OPERATION

These procedures are intended for use in simple metering applications where the flow of liquid through the meter is controlled by hand-operated valves located in the facility piping upstream and downstream of the meter.

- 1. Slowly open the upstream valve; apply liquid to meter.
- Slowly open the downstream valve to initiate metering.
- 3. Adjust the downstream valve so that the rate of flow does not exceed the maximum continuous flow rate specification of the meter.
- To stop metering, slowly close the downstream valve, then close the upstream valve.

b. ACCESSORY CONTROLLED OPERATION

The step-by-step operating procedures used in accessory controlled metering applications are dependent on the specific function of the meter-accessory employed and its electrical or pneumatic interconnection with the flow control device or devices. Refer to the IOM manuals covering the applicable accessories for specific operating instructions.

SHUTDOWN INSTRUCTIONS

If the turbo meter is to be shutdown for an extended period of time, it is recommended that the measuring chamber be thoroughly flushed to prevent the settling out of undissolved solids or the accumulation of corrosive deposits.

MAINTENANCE

MAINTENANCE EQUIPMENT

With the exception of a special change gear mesh gage and a calibration test tank, the tools required are the usual compliment of standard hand tools used by plumbers and mechanics.

Truarc Right-Angle Pliers Truarc P/N 1549 (Badger P/N 57321-1)

Change Gear Mesh Gage Badger P/N 21747

PREVENTIVE MAINTENANCE

a. PERIODIC INSPECTION

- Visually inspect the turbo meter and meter-mounted accessory. Repair or replace components as required based on the visual inspection.
- Verify that the meter operates at the proper flow rate and pressure. A loss in pressure, coupled with the resulting decrease in flow rate, may indicate the screen in the upstream pipeline is clogged with material and requires cleaning.

b. CLEANING

- Clean all dust, dirt, grease, moisture or other foreign material from the exterior of the meter and meter-mounted accessory.
- If the piping arrangement of the facility includes a flushing system, shutoff the liquid flow to the meter. Flush the interior of the meter with an appropriate cleaning fluid to remove any buildup of deposits or corrosion on the internal portion of the meter.

CALIBRATION CHECK AND ADJUSTMENT

Accuracy of Badger turbo meters is tested at the factory with water. However, due to possible use of liquids that could vary in viscosity, it may be necessary to recalibrate a meter under operating conditions. The following instructions are to assist in performing a calibration adjustment.

a. ACCURACY TEST

- 1. Place a test tank of known volume at output of meter.
- 2. Operate the meter until the test tank is filled to a calibrated level. Run at the actual flow rate used in the operation
- 3. Record the quantity indicated on the meter accessory.
- 4. Perform the following calculations to determine percent of accuracy of the meter-accessory combination:

Oty. Indicated on Accessory
Actual Quantity in Test Tank

EXAMPLE 1:

In this example, the accessory is slow and must be speeded up by a change gear or electronic scaling correction.

EXAMPLE 2:

In this example, the accessory is fast and must be slowed down.

b. CHANGE GEAR CORRECTIONS

If the test indicates that an adjustment is required, proceed as follows:

- 1. Remove the change gears from the spindles by loosening the setscrew. NOTE: Both the O.D. dimension (in decimal inches) and the number of teeth are stamped on each gear.
- 2. Calculate the ratio of existing change gears as follows:

3. Calculate the new change gear ratio required by multiplying the ratio of existing change gears by percent-of-meter accuracy determined in test.

EXAMPLE:

Existing Change Gear Ratio =
$$\frac{42 \text{ Teeth}}{43 \text{ Teeth}} = .976$$

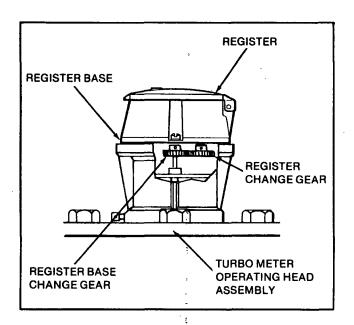
Meter Accuracy = 95 %

Corrected Change Gear Ratio = .976 x
$$\frac{95}{100}$$
 = .927

4. Select a combination of new change gears that match the corrected change gear ratio. If stocked change gears are not available, submit order for change gears to your nearest Badger Meter representative or the Industrial Division of Badger Meter Inc.

NOTE: When ordering, give the serial number of the turbo meter which is stamped on the outlet flange of the meter. Specify the meter size and accessory employed along with the number of teeth and diameter on existing change gears. Specify the corrected change gear ratio.

5. Install the corrected change gears, taking care that the correct change gears are assembled to the appropriate spindles (see example in figure below). For registers, refer to Servicing section for instructions covering the proper method of installing and meshing change gears. On meters with 76 Series registers, provision for change gear adjustment is built in. See the applicable register IOM manual for recalibrating instructions.



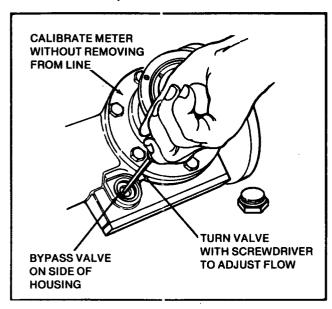
Change Gear¹Location
Register Base and Register Assembly

c. ELECTRONIC SCALING CORRECTION.

If the test results indicates an adjustment is required, see the instruction manual for that accessory for procedure to change scale factor.

CALIBRATING 2" AND 3" METERS

Badger's 2" and 3" turbo meters with bronze and cast iron housings are equipped with a bypass valve for "minor" calibration adjustment in the field. Test the meter's accuracy to determine if recalibration is required. If the meter is out of calibration, proceed as follows:



Calibrating 2" and 3" Turbo Meters

- 1. Remove the bypass cover nut with a wrench.
- 2. Using a wide-bladed screwdriver, loosen the bypass valve lock ring.
- 3. Adjust the bypass valve with a screw drive in the following manner (see page 5):
- a. To INCREASE reg.stration, turn the slot in the valve perpendicular to the axis of the meter (line of flow). This will restrict the amount of volume flowing through the bypass and increase flow through the metering chamber.
- b. To DECREASE registration, turn the slot in the valve parallel to the axis of the meter. This will increase liquid volume through the bypass and decrease flow through the metering chamber.

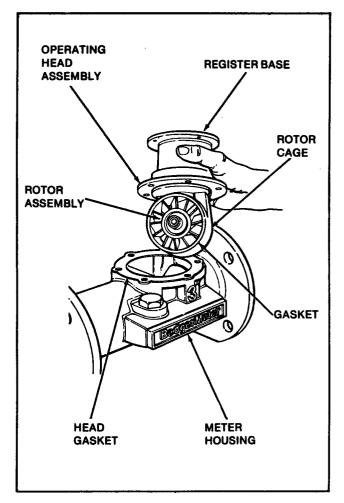
NOTE: The total range of the bypass adjustment occurs within a 90 degree or quarter turn of the valve from the parallel, inline position to the perpendicular position, or vice versa. The total range of adjustment is about four percent. Tested and calibrated at the factory, the bypass valve will be set at about 45° from the full "open" or "closed" position. This setting will allow for a ±2% adjustment to recalibrate the meter in the field.

- 4. With the valve turned to the desired bypass setting, tighten the valve lock ring.
- 5. Install and tighten the bypass valve cover nut.
- 6. Retest the meter to confirm the accuracy of the bypass adjustment. If the meter is still out of calibration, repeat the procedure outlined above.

REGISTER BASE REPLACEMENT

Badger turbo meters can be serviced without removing the meters from the system. To inspect or replace component parts of the head assembly, close the upstream and downstream valves. If the installation is equipped with an inlet and drain valve for flushing the meter, open the drain valve to relieve pressure from within the meter. However, if the meter piping is not equipped with a drain valve, proceed as follows to relieve pressure within the meter:

- 1. Do not remove the register base from the operating head assembly. The entire head assembly must be removed as a complete unit (See figure below).
- 2. Loosen each of the head bolts about one and one-half turns. Do not remove the bolts completely.
- 3. If the gasket-seal between the meter head and the housing is not leaking at this time, pry the head assembly loose with a screwdriver. To accomplish this, insert the screwdriver from the outlet side of the head assembly where the head and housing join together.



Turbo Meters Serviced Without Removal from the Line

CAUTION: Exercise precaution to make certain that fluid does not spray from the meter. The liquid spray could contact electrical equipment and create an electrical hazard.

- 4. Allow the meter to drain and relieve internal pressure.
- 5. When pressure is relieved, remove the head bolts and shift the head assembly toward the outlet-end of the meter to release the head-to-housing seal. Then lift the entire head assembly from the housing and, at the same time, tilt the operating head up to prevent the rotor from falling off the rotor spindle.

NOTE: Rotors are furnished with two-pole or four-pole magnets depending on the type of accessory.

6. When the operating head has been removed, lift the rotor out of the rotor cage and set it aside. Remove the head gasket.

NOTE: A dummy cover plate is available to close the meter in the line and continue service while the operating head assembly is being inspected or parts are being replaced.

- 7. To remove the register base from the head assembly, loosen the seal screw on the base with a screwdriver. Rotate the base 45 degrees in either direction to release it from the bayonet lock detents on the head assembly.
- 8. The register base retaining ring is accessible through the rotor cage in the head assembly. With a Truarc right-angle pliers #1549, expand and remove the register retaining ring on the extension tube. When this is accomplished, the register base can be removed from the head assembly.
- 9. To reinstall or replace the register base, repeat the procedure above in reverse making sure that the retaining ring has been reinstalled on the extension tube.

NOTE: The head unit has a gasket bonded to the periphery of the rotor cage. Depending on the chemical solution to be metered, the gasket will be made of EPR, Buna N or Viton A material. Re-inserting the head assembly into the meter housing correctly will require compressing the gasket slightly. This is done by tilting the top of the register base on the head toward the inlet side of the meter. The meter head has a pilot diameter machined into the cage at the gasket face. This pilot diameter must extend through the housing gasket inner diameter and into the housing bore. After lowering the head assembly into the housing, move the entire head assembly straight toward the inlet side of the meter. The pilot diameter must snap into the bore of the housing to provide a tight seal.

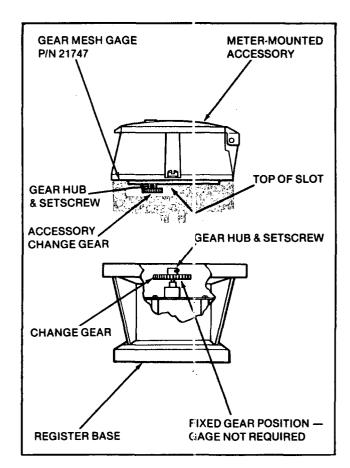
- 10. With the head gasket aligned and the head assembly properly positioned in the housing, reinstall and tighten the head bolts (between 90-180 in.-lbs. of torque).
- 11. Close the flushing system drain valve, open the upstream valve partially, then open the downstream valve slightly which will purge any air from the service line. Then open both valves completely.

SERVICING

Refer to the following paragraphs for instructions covering the removal, inspection and installation of service parts and assemblies. Any service or repair procedures that apply to a meter-mounted or free-standing accessory are provided in the IOM instruction manual pertaining to that device (also provided as a supplement to this manual.) If satisfactory repair cannot be made, contact the Industrial Division of Badger Meter, Inc.

a. CHANGE GEAR REPLACEMENT

- 1. Replacing the change gear on the register base spindle requires no gage to properly mesh this gear with the register change gear. A shoulder-stop is built into the spindle at the proper gear height thus eliminating gear adjustment.
- 2. The change gear in the register should be installed with the aid of a Badger change gear mesh gage (P/N 21747) to ensure proper gear n.esh. The procedure is as follows:



Replacing Turbo Meter Change Gears

- a. Place the bottom of the register on the top edge of the gage (see Figure page 6).
- b. Adjust the change gear on the register spindle so that it rests against the "top" of the slot in the gage. Holding the change gear in this position, tighten the setscrew in the hub of the change gear.

NOTE: Install the change gears on the spindles with the hub of the gears in the "UP position.

c. Carefully install the register on the base making sure that the gears fully mesh. Install and tighten the register seal screws.

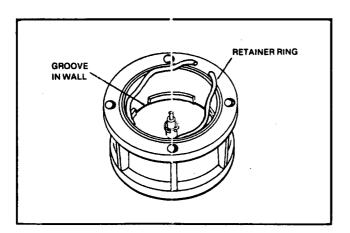
CAUTION: Take care not to bend the spindles when installing the gears or reassembling the register to the register base.

INSTRUCTIONS FOR REMOVING THE GEAR TRAIN ASSEMBLY WITH MAGNET

The gear train assembly can be removed and replaced without removing the turbo meter from the line.

Two gear train assemblies are used with industrial turbo meters. To find out what the gear train ratio is, count the number of spindles (gear and pinions) that protrude through the five mounting holes provided in the top plate of the gear train assembly. If there are only three spindles, the gear ratio is 366:1 and if there are five spindles, the gear ratio is 1200:1.

1. Remove the register, transmitter or adapter mounted on the register base.



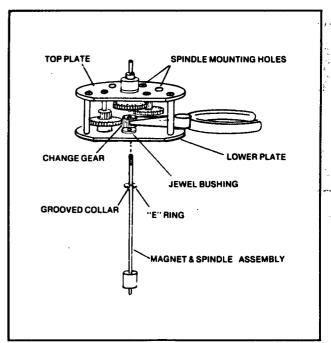
Release the retainer ring from the groove to free the gear train assembly from the base

- Use a small screwdriver to release the retainer ring from the groove in the wall adjacent to the top plate of the gear train assembly.
- Grip the change gear spindle and lift to remove the gear train assembly with magnet from the register base.

4. Remove the accessory change gear or coupling from the gear train spindle. Before removing, note the location of the change gear (or coupling) on the spindle so that it can be reinstalled in the same location.

NOTE: A flat surface is provided at the top of the spindle of the change gear assembly so that the setscrew in the change gear or coupling can be properly seated and tightened to the spindle.

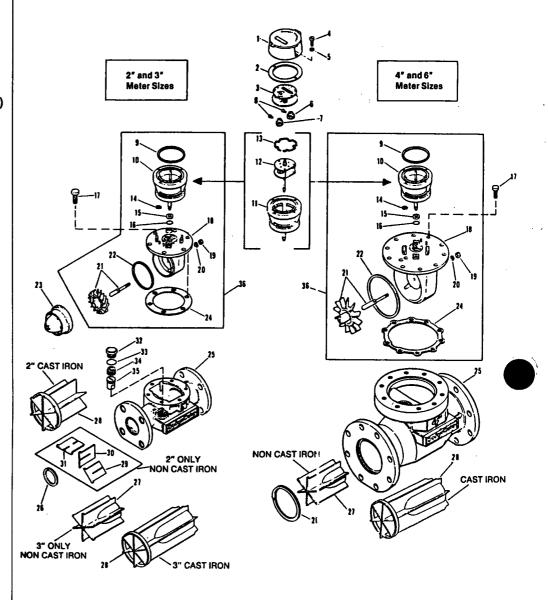
5. Gear train assemblies are packaged with the magnet and spindle assembly disassembled from the gear train assembly. Before assembling, carefully check the spindle for minute burrs on the threaded end of the spindle. If there are burrs, use a crocus cloth and carefully remove them from the spindle. This will prevent damage to the surface of the jewel bearing when inserting the magnet spindle through the jewel-bushing in the bottom plate of the gear train assembly. An "E" ring should be mounted on the spindle. If missing, remove the "E" ring from the replacement spindle and snap it into the grooved collar near the threaded end of the spindle.



installing the magnet spindle assembly to the gear train assembly

ILLUSTRATED PARTS LIST

<u></u>	
ITEM	DART DECORIDEION
NO.	PART DESCRIPTION
1	Hood, Register, 258
2	Gasket, Register Hood
3	Screw, Register Cover, 258
4	Screw, Register Cover, 258
5	Lock Washer, Register, 258
- 6	Change Gear, Accessory (Note 5
7	Change Gear, Adapter (Note 5)
8	Setscrew, Change Gear
.9	Tetraseal, Base Assembly
. 10	Register Base Assy. (Note 4)
11	Register Base Only
12	Gear Train, Base Assy. (Note 4)
13	Retaining Ring, Base Assy.
14	Retaining Ring, Register Base
15	Spacer, Register Base
16	Tetraseal, Meter Head Adapter
17	Bolt, Hex., Meter Head
18	Meter Head, Machined
	(Notes 2 & 6)
19	Nut, Hex., Rotor Spindle
20	Lock Washer, Rotor Spindle
21	Rotor & Spindle Assy. (Note 3)
22	Tetraseal, Meter Head (Note 1)
23	Nose Cone (Note 2)
24	Gasket, Head Assy. (Note 2)
25	Housing (Note 1)
26	Retaining Ring,
	Straightening Vane
27	Straightening Vane Assy.,
	Bronze, Cast Steel,
	Stainless Steel
28	Straightening Vane Assy.
	(Cast Iron Only)
29	Straightening Vane (2" Only)
30	Straightening Vane (2" Only)
31	Straightening Vane (2" Only)
32	Nut, Bypass Cover
33	"O" Ring, Bypass (Note 2)
34	Lock Ring, Bypass
35	Bypass Mater Head Apply Complete
36	Meter Head Assy., Complete
	(Notes 2 & 6)



NOTE 1 Advise body material, flange rating (150 psi or 300 psi).

NOTE 2 Material will depend on corrosiveness of fluid being metered.

NOTE 3 Number of poles in magnet will depend on type of meter accessory.

NOTE 4 Gear train ratio is marked on plate of adapter (i.e., 1200:1 or 366:1).

NOTE 5 Number of teeth and gear diameter is stamped on each gear.

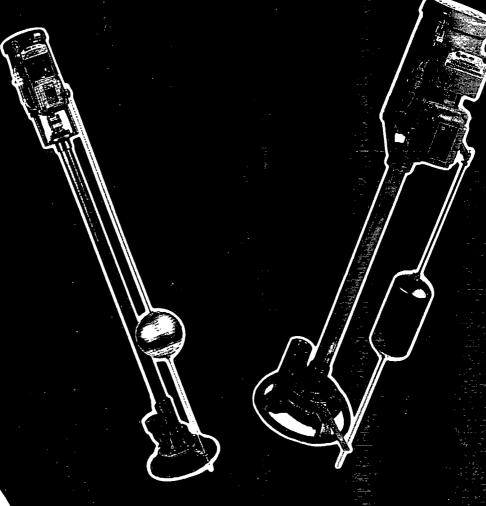
NOTE 6 Advise size of meter.

NOTE 7 Advise units of measure (i.e., gallons, m3, etc.)

APPENDIX C-9
Building Sump Pump



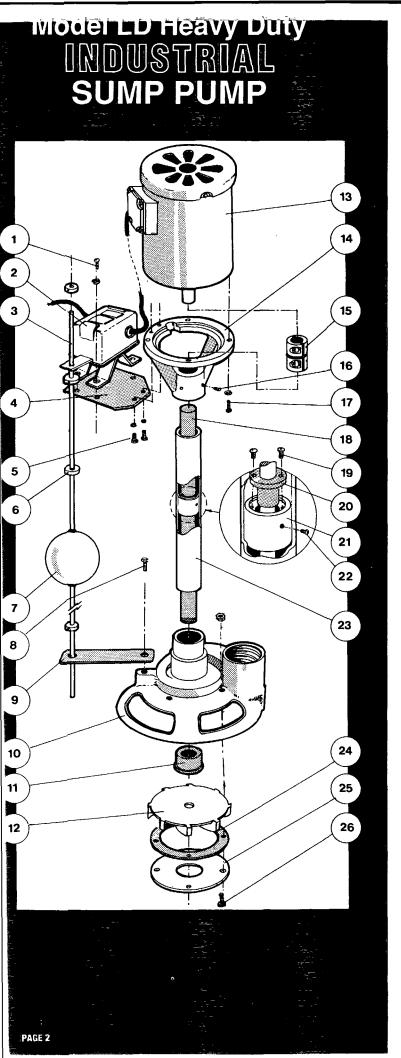
- INSTALLATION INSTRUCTIONS
- PARTS LIST
- MAINTENANCE





PUMP MANUFACTURING CO.

PHONE 609-228-5488
110 HARMON DRIVE, SUITE F, BLACKWOOD, NJ 08012



LD PARTS LIST

- 2. SWITCH- Open Drip/TEFC (Shown in sketch) (See page 3 for explosion proof configuration)
- 3. TRIP ROD (Brass or Stainless)
- 4. SWITCH MOUNTING PLATE
- 6. ADJUSTMENT COLLARS (4 Required)
- 7. FLOAT
- 9. TRIP ROD GUIDE
- 10. BASE (Cast Iron, Brass or Stainless)
- 11. BUSHING
- 12. IMPELLER (Brass or Stainless)
- 13. MOTOR (Specify Type)
- 14. MOTOR MOUNT

(Pumps 4' height and over utilize motor mount and bearing configuration. Shown on page 3.)

- 15. COUPLING
- 18. SHAFT (Specify length)
- 20. INTERMEDIATE BUSHING

(on pumps 4' height

- 21. INTERMEDIATE BUSHING HOLDER

and over)

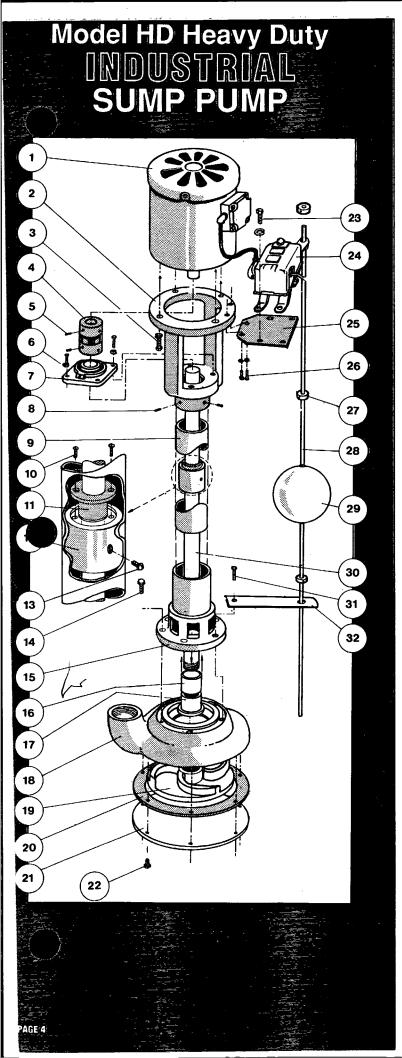
- 23. COLUMN/SHAFT HOUSING (Specify Type)
 (Steel, Brass or Stainless)
- 24. GASKET
- 25. BOTTOM PLATE

(316 S/S or strainer 304 S/S)

HARDWARE

Below is a list of all hardware used in our LD pump. The item numbers correspond to those identified in the exploded view to the left. All items of hardware used are of standard sizes and threads, and should be available from most industrial hardware suppliers and many local retail hardware stores. These descriptions are presented for your convenience should any replacement be necessary.

# SIZE	DESCRIPTION	REQ'D
1. 1/4-20 X 1/2"	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
5. 1/4-20 X 1/2"	HEX HEAD SCREWS & LOCK WASHERS	2 Sets
8. 1/4-20 X 1/2"	HEX HEAD SCREW S/S	1 REQ'D
16. 5/16-18 X 5/16"	SET SCREWS S/S	2 REQ'D
17. 3/8-16 X 1°	HEX HEAD SCREWS & LOCK WASHERS	4 SP
19. 6-32 X 3/8"	ROUND HEAD SCREWS	2 F
22. 8-32 X 3/8"	ROUND HEAD SCREWS	2 REG C
26. 10-32 X 1"	ROUND HEAD SCREWS & NUTS	4 SETS REQ'D



HD PARTS LIST

- 1. MOTOR (Specify type)
- 2. MOTOR MOUNT CASTING
- 4. FLEXIBLE COUPLING
- 6. ADJUSTMENT COLLARS
- 7. FLANGE MOUNTED BEARING ASSEMBLY
- 9. COLUMN/SHAFT HOUSING (Brass or Stainless)
- 11. INTERMEDIATE BUSHING
- 12. INTERMEDIATE BUSHING HOLDER
- 15. INLET CASTING
- 16. STRAIGHT BUSHING

(Sold as sets)

- 17. BOTTOM FLANGED BUSHING
- 18. BASE (Cast Iron, Brass or Stainless)
- 19. IMPELLER (Brass or Stainless)
- 20. GASKET
- 21. BOTTOM PLATE
- 24. SWITCH-Open Drip/TEFC
 (See page 3 for explosion proof configuration)
- 25. SWITCH MOUNTING PLATE
- 27. ADJUSTMENT COLLARS (4 req'd)
- 28. TRIP ROD (Brass or Stainless)
- 29. FLOAT
- 30. SHAFT (Specify length)
- 32. TRIP ROD GUIDE PLATE

HARDWARE

Below is a list of all hardware used in our HD pump. The item numbers correspond to those identified in the exploded view to the left. All items of hardware used are of standard sizes and threads, and should be available from most industrial hardware suppliers and many local retail hardware stores. These descriptions are presented for your convenience should any replacement be necessary.

# SIZE	DESCRIPTION	REQ'D
3. 3/8-16 X 1°	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
5. 5/16-18 X 5/16"	ALLEN SOCKET SET SCREWS	4 REQ'D
6. 5/16-18 X 1"	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
8. 5/16-18 X 5/16"	ALLEN HEAD SET SCREWS S/S	2 REQ'D
10. 6-32 X 3/8"	ROUND HEAD SCREWS S/S	2 REQ'D
13. 8-32 X 3/8"	ROUND HEAD SCREWS S/S	2 REQ"D
14. 5/16-18 X 1"	HEX HEAD SCREWS S/S	5 Req"D
22. 1/4-20 X 1/2"	HEX HEAD SCREWS S/S	7 REQ'D
23. 1/4-20 X 1/2"	HEX HEAD SCREWS & LOCK WASHERS	4 SETS
26. 1/4-20 X 1/2"	HEX HEAD SCREWS & LOCK WASHERS	2 Sets
31. 5/16-18 X 1"	HEX HEAD SCREW S/S	1 SET

PRELIMINARY INSPECTION

As you uncrate your Neptune pump, check for any visible damage that may have occurred during shipping. Report any such damage to your distributor immediately.

Place the pump in an upright position, being sure not to let it tip over...it will be top heavy! Grasp the coupling just below the motor and turn the pump shaft. It should turn freely.

INSTALLATION and **ELECTRICAL CONNECTION**

The pump operation is controlled by a float-activated switch. Travel limits of the float are determined by the location of two adjustable collars on the trip rod. These collars should be set into position prior to final installation. To minimize wear on the starting mechanism, on/off intervals of operation should be longer than five minutes, if possible.

Only a qualified electrician should make the necessary hook-up of electric power, one familiar with the industrial wiring codes in your area. Single phase pump motors are factory wired to provide proper rotation of the pump shaft.

Three phase hook-ups must be checked for proper rotation as indicated by the arrow label on the pump shaft housing. If rotation is not correct, switch any two lead wires.

Though our single phase motors have built-in overload protection, some commercial wiring codes require an external overload relay. Three phase motors should utilize external overload and starting relays activated by the float switch. For explosion-proof installations, the external controls must be rated and classified for hazardous environments.

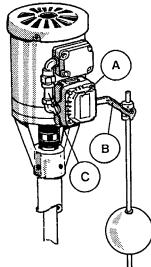
MAINTENANCE

Neptune pumps are virtually maintenance free. After prolonged use, however, the shaft's bushings may need to be replaced. Symptoms of the need to replace the bushings may be evident when a high speed vibration or chatter can be heard.

WARRANTY

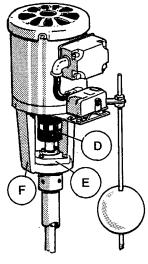
The only part of a Neptune pump that requires a warranty is the electric motor which is covered by the motor manufacturer's warranty against defect.

EXPLOSION PROOF MOTOR/SWITCH DETAIL



For explosion-proof installations, a totally-enclosed vertical switch "A", with an anodized float switch arm "B", and a totally enclosed wire housing "C" are used in accordance with federal safety guidlines for hazardous installations.

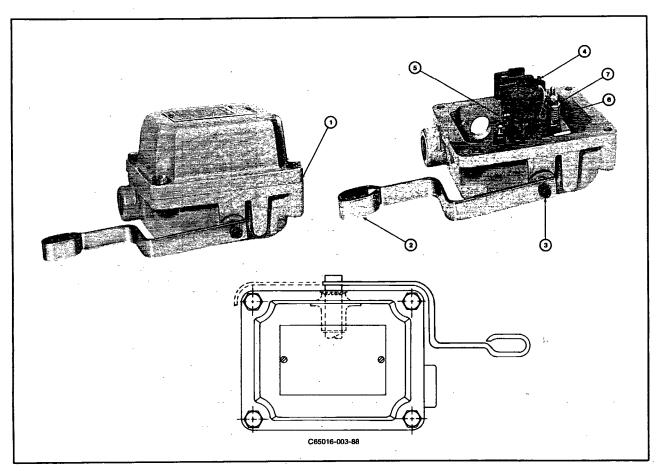
LD SUMP PUMP (over 4') MOTOR/MOTOR MOUNT DETAIL



For LD pumps longer than 4', the motor mount "F", flexible coupling "D", and flange mounted bearing assembly "E", as used on the HD pumps, are substituted for the motor mount and coupling shown in the LD sketch. This is done to provide extra stability to the longer shafts.

BULLETIN

Class 9036 Type DR and DW Series A **Including Forms**



Instructions

APPLICATION—Opens and closes an electric circuit by an upward or downward movement of the lever arm, as in controlling the liquid level in a receiving tank or sump.

MOUNTING—Switch is mounted in a horizontal position, using mounting feet provided.

STANDARD OPERATION—The standard setting for the Class 9036 float switch is so arranged as to close the circuit at high liquid level and open at low liquid level.

REVERSE OPERATION—The standard action can be reversed; that is, close the circuit at low liquid level and open at high liquid level by

reversing the lever position, (See drawing), and changing the spring item 6, and cup washer item 7.

ACCESSORIES—The standard accessories (9049A-6) furnished with this switch (when specified) consist of a 7 inch tapped-at-top float, 5 feet of %" tubing and 2 adjustable stop collars.

MOTOR PROTECTION—A float switch of this type does not afford motor protection. However, it is quite frequently used as a pilot to operate a starter providing these desirable features. Square D Company manufactures a complete line of motor protective switches, information on which will be sent upon request.

Supersedes 806 AS Dated April. 1984

SQUARE

65013-013-99



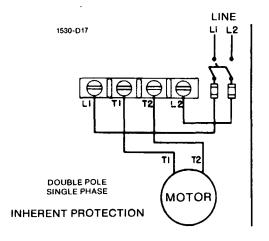
SERVICE BULLETIN

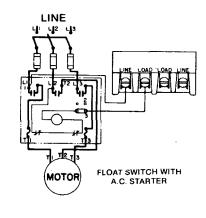
	PARTS L	IST			
ltem	Description	Part Number	DR-31, DW-31	DR-31 Form C, DW-31 Form C	DR-31 Form R, DW-31 Form R
1	Cover Gasket	1546-L11-X1	1	1	1
2	Operating Lever*	65079-034-01	1	1	1
3	Crank	1546F5X1	1	1	1
4	Replacement Contacts	Class 9998 PC 242	1	1	1
5	Switch Mechanism*	Class 9998 PC 285	1	-	-
	Switch Mechanism*	Class 9998 PC 286	-	1	-
	Switch Mechanism*	Class 9998 PC 287	-	-	1
6	Spring	4204-X3	-	-	1
7	Cup Washer	306-D1-X7	-	-	2

(DW Types Only)

Complete set of contacts (movable and stationary)

* Consult factory or local field office for availability of replacement parts for special devices.





PAGE 2



INSTALLATION - MAINTENANCE INSTRUCTIONS

The safety of personnel depends upon following these instructions:

RECEIVING:

Inspect machine before accepting shipment for any damage in transit. Shaft should turn by hand without any rubs. Any damage from transit should be reported to the carrier immediately.

INSTALLATION

Qualified or trained personnel should install the machine. Electrical rotating equipment can result in property damage, serious injury, or death, when improperly installed. Equipment should be installed in accordance with the National Electrical Code, local codes and with NEMA MG2, Safety Standards for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.

WARNING: Observe the following for safety:

- When eyebolts are provided, they are intended only for lifting the motor and its included motor accessories. Eyebolt must be fully tightened.
- 2. The machine **must** be grounded in accordance with the National Electrical Code and any local code.
- 3. Permanently guard machine against accidental contact of body parts or clothing with moving parts.
- 4. Shaft key must be secured before starting motor.
- 5. The machine should match the line voltage, line frequency, and the equipment load.
- Applications for motor-mounted brake should have proper safeguards provided for personnel in case of possible brake failure.
- 7. Remove all power services and allow machine to reach standstill prior to servicing.
- 8. On single phase motors discharge start and/or run capacitors prior to servicing.
- 9. Do not by-pass or render inoperative safeguard or protective devices.

MOTOR ENCLOSURE

Open drip proof motors are intended for use in clean, dry locations with access to an adequate supply of cooling air. In addition, there should be protection from or avoidance of flammable or combustible materials in the area of open-type motors as they can eject flame and/or molten metal in the event of an insulation failure. Totally enclosed motors are intended for use where moisture, dirt, and/or corrosive materials are present in indoor or outdoor locations. Explosion-proof motors, as indicated by the Underwriters Laboratories, Inc. label, are required for hazardous locations in accordance with the National Electrical Code.

MOUNTING

Foot mounted machines should be mounted to a rigid foundation to prevent excessive yibration. Shims may be required if foundation is uneven.

Flange mounted machines should be properly seated and aligned. NOTE: If improper direction of rotation is detrimental to the load, check rotation prior to connecting the motor to the load.

For V-belt drive, mount the sheave (pulley) close to the motor housing, however, allow clearance for end to end movement of shaft. Do not overtighten belts as this may cause premature bearing failure and/or shaft breakage.

Direct coupled machines should be carefully aligned and shaft should turn freely without any binding.

WIRING

Connect the machine in accordance with furnished connection diagram. The wiring, fusing, and grounding must be in accordance to the National Electrical Code and any local codes.

When the machine is connected to the load for proper direction of rotation and started, it should start quickly and run smoothly. If this is not the case, immediately shut motor off. Investigate the cause. The cause could be; low voltage, the motor is misconnected, or the load is too great, etc.

It is recommended that the motor current be checked after it has been operating a short time and compared against nameplate current.

LUBRICATION

This is a ball bearing motor. The bearings have been given initial lubrication at the factory. Motors without regreasing capability are factory lubricated for normal bearing life.

RELUBRICATION INTERVALS (MOTORS HAVING REGREASING CAPABILITY)

New motors having been in storage for over a year should be relubricated by the procedure noted below. The following relubrication intervals are suggested as a guide for long operating life.

	Suggested Relube Interval						
Hours of Service Per Year	NEMA FRAME SIZE						
	42 to 215T	254 to 326T	364 to 447T				
5000 Hrs.	5 yrs.	3 yrs.	1 yr.				
Continous Normal Application	2 yrs.	1 yr.	9 months				
Seasonal Service Motor is idle for 6 months or more	1 yr. (beginning of season)	1 yr. (beginning of season)	1 yr. (beginning of season)				
Continuous high ambients, dirty or moist locations, high vibration, or where shaft end is hot (pumps-fans)	6 months	6 months	3 months				

LUBRICANT

Baldor motors are pre-greased normally with Shell Oil Company's "Dolium R". Several equivalent greases which are compatible with the Baldor furnished grease are Chevron Oil's "SRI No. 2" and Texaco Inc. "Premium RB".

PROCEDURE

Overgreasing bearings can cause premature bearing failure. If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215 frame and smaller. Use 2 to 3 strokes on NEMA 254 thru NEMA 365 frame. Use 3 to 4 strokes on NEMA 404 frames and larger. On motors having drain plugs, remove grease drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215 frame and smaller. Insert 3 to 5 inch length on larger motors. Motors having grease drain plugs, remove plug and operate motor for 20 minutes before replacing drain plug.

CAUTION: Keep grease clean. Lubricate motors at standstill. Remove and replace drain plugs at standstill. Do not mix petroleum grease and silicone grease in motor bearings.

Additional copies may be obtained at no charge by writing: Baldor Electric Company, P.O. Box 2400, Fort Smith, Arkansas 72902.

APPENDIX C-10 Tanks



Steel Tank Institute

Installation Instructions For Factory Fabricated Aboveground Tanks R912-91

Revised April 4, 1991

READ ALL INSTRUCTIONS BEFORE INSTALLATION

1.0 FOUNDATION PREPARATION

- 1.1 The foundation must be designed to support tanks on a well drained stable concrete, asphalt or bedding material which prevents movement, rolling or uneven settling of the tank, and is designed to minimize corrosion of the tank bottom.
- 1.2 For tank installations without corrosion protection, a static electricity grounding system should be installed for the tank in accordance with applicable National Association of Corrosion Engineers and applicable Electrical and Fire Code Standards.
- 1.3 For tank installations with corrosion protection, consult (NACE) recommended standards to provide the tank with appropriate protection from static electricity without disruption of corrosion protection.
- 1.4 Consult National Fire Protection Association publication NFPA 30, the Uniform Fire Code, and your local fire marshal and building inspectors for all applicable codes and restrictions such as spacing from buildings, property lines, public ways, etc.

2.0 TANK HANDLING

- **2.1** Equipment handling shall be of adequate size to lift and set tank without dragging or dropping.
- 2.2 Tanks shall be carefully lifted and set by use of cables or chains of adequate length attached to the lifting lugs provided.
- 2.3 Do not handle or install tank without knowledge of proper procedures and inherent dangers involved

with tank installation for storage of flammable and combustible liquids. Reliance on skilled, professional installers is an *important* factor in avoidance of system failures.

2.4 DO NOT MOVE TANK UNLESS EMPTY.

2.5 This is a stationary tank. Do not use for transport of any product over roads and highways.

3.0 AIR TEST

- 3.1 An on-site air test of the tank is required to insure no damage has occurred in shipping and handling.
- 3.2 To prepare the tank for the air test, remove all thread protectors and install metal pipe plugs properly prepared with compatible thread compound. Remove emergency vents and install properly prepared metal plug in the tank vent threaded opening. If a long-bolt (floating cover) manhole is used as an emergency vent, the top must be secured by temporarily installing regular bolts or other clamping devices.
- 3.3 For single wall tanks, Internal tank Air Test Pressure should not exceed 1½ pounds per square inch (PSIG) for vertical steel tanks and should not exceed 5 pounds

per square inch (PSIG) for horizontal tanks. A soap solution is to be applied to all exterior tank surfaces, including all weld seams and fittings, while the tank is pressurized to test for leaks.

3.3.1 CAUTION

TANKS CONTAINING AIR PRESSURE MUST NOT BE LEFT UNATTENDED. Atmospheric temperature could effect internal pressure.

3.3.2 Pressure gauges must be accurate (±2%) with a maximum gauge dial scale range of 15 pounds per square inch (PSIG).

3.0 AIR TEST (Continued)

- 3.3.3 Aboveground vertical tanks may have a "weak shell to roof" seam. Keep personnel away from the tank top during application of air pressure.
- 3.3.4 DO NOT APPLY A VACUUM TO THE PRIMARY TANK OR A SINGLE WALL TANK.
- 3.4 For double wall tanks consult tank manufacturer for air testing recommendations.
 - 3.4.1 **<u>DO NOT CONNECT</u>** the air pressure line from the compressor to the interstitial monitoring port

of a dual wall tank. Air pressure test the inner primary tank only.

- 3.4.1.1 For Type I dual wall tanks, <u>vacuum</u> testing of the interstital space of a dual wall tank can be used instead of, or in addition to, air pressure testing of the primary tank.
- 3.4.2 After air testing is completed, discharge compressed air from the tank before dismantling testing equipment and then re-install proper vents.

4.0 TANKS

- **4.1** All UL 142 listed tanks must have a means for emergency relief venting. Check with manufacturer for design type.
- **4.2** All tanks, including UL 142 listed tanks, must have a normal vent of adequate size for atmospheric venting (check local codes).
- 4.3 Install all permanent fittings and accessories. Use

compatible, non-hardening sealant material.

- **4.4** All unused openings must be properly plugged with threaded metal pipe plugs.
- 4.5 DO NOT MODIFY TANK STRUCTURE IN ANY WAY. DO NOT WELD ON TANK.

5.0 LABELING

- **5.1** Tanks shall be labeled in accordance with applicable regulations.
- 5.2 Unsupervised, isolated aboveground storage tanks shall

be secured and marked to identify fire hazards of tank and its contents to the general public. The tank area shall be protected from tampering or trespassing where necessary.

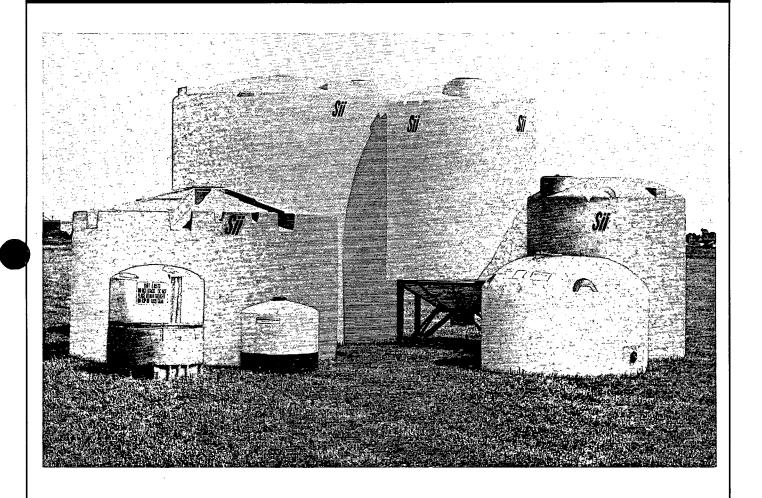
6.0 SECONDARY CONTAINMENT

- **6.1** Secondary containment may be steel, concrete or other approved material. Consult federal, state or local authorities.
- **6.2** Facilities shall be provided so that any accidental discharge of Class I, II or IIIA liquids will be prevented from endangering important facilities adjoining property or reaching waterways.
- 6.3 The secondary containment dike must be engineered for strength and sized to contain the greatest amount of liquid that can be released from the largest tank,
- plus the volume displaced by other tanks below the height of the dike. Local codes may require additional freeboard.
- 6.4 When steel secondary containment is employed, it is recommended that a suitable vehicle barrier be provided. One such method may typically be a 4-inch metal pipe "Bumper posts" filled with concrete installed at least 2 feet away from the tank, if the tank is subject to traffic damage. The pipe must be a minimum of 42 inches below ground level and 36 inches above ground level.

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Were Callonis





Portable Nurse and Liquid Transport Tanks

A number of Snyder's vertical tank models are wellsuited for transporting liquids of all kinds, making them ideal for use as portable nurse tanks. Of course, many of the larger portable models are also suitable for stationary storage applications as well. These tanks offer the following standard features:

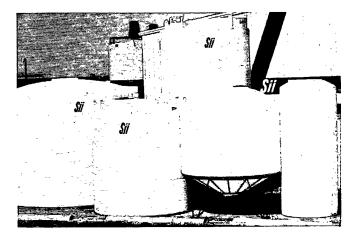
■ Large fill openings and 2" outlets for fast, easy draining of materials.

■ Ultraviolet inhibitors that help protect the tank and its contents from the sun's damaging rays.

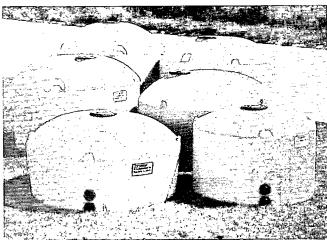
■ Molded-in tie-down lugs for securing tanks.

■ Easy-to-read molded-in gallonage indicators that provide a convenient way to determine the volume of the tank's contents.

■ Siphon tubes to help drainage.



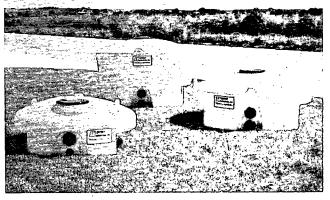
Agri-Tanks



The Snyder Agri-Tank line includes a variety of tank sizes and styles designed specifically for demanding agricultural applications. Vertical Agri-Tanks feature two heavy-duty outlet fittings for fast discharge under rugged field conditions. They offer a number of design features that make them the tank of choice in the ag industry. Vertical Agri-Tanks are available in sizes from 550 to 1,650 gallons.

(Special use tanks in 22 and 65-gallon sizes are also available.)

Utility Tanks



The quick and easy way to move liquids and chemicals. These versatile nurse/transport tanks feature a unique notched design that is tailored to fit over the rear wheel wells of most pickup trucks. They are available in 150, 300 and 465 gallon capacities.

Bulk Storage Tanks

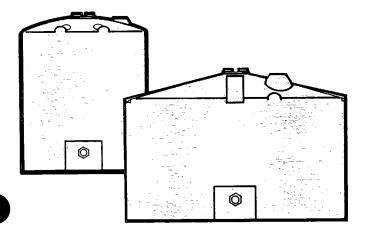
Snyder bulk storage tanks are designed for a wide variety of industrial and agricultural uses. They're built to meet the special demands of bulk chemical handling — engineered to handle the stress caused by higher weight chemical solutions. Tanks are available to handle materials up to a specific gravity of 1.9.

In addition to their tremendous durability, Snyder bulk storage tanks are also lightweight. They are easier to move than steel or fiberglass tanks, and much easier to maintain. Snyder gives you what your business demands — high-quality, reasonably priced tanks that are built to stand up to the most demanding field use. Snyder bulk storage tanks are available in many sizes, up to 22,000 gallons — the world's largest rotationally-molded tank. And they give you a lot of extras not found in other tanks.

- Snyder engineering includes the ability to program wall thickness to provide extra reinforcing in high stress areas of the tank.
- Deep siphon tubes go to the bottom of every Snyder bulk storage tank for withdrawal from the bottom.
- An 18" lid is standard. Larger sizes are available.
- Molded-in tie-down lugs are standard on every Snyder bulk storage tank.
- Snyder tanks feature threaded lids with an integral 5" threaded vented fill cup to securely close the fill opening.
- \blacksquare Color pigments and ultraviolet inhibitors help protect tank and contents from sun damage.

Flat-Bottom Tanks

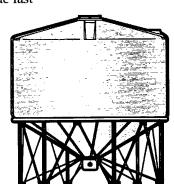
Snyder flat-bottom bulk storage tanks are available in both rib-top and dome-top styles, in sizes from 2,000 to 22,000 gallons.



Cone-Bottom Tanks

For fast discharge and complete drainage, Snyder offers rib-top and dome-top cone-bottom bulk storage tanks, in sizes ranging from 1,000 to 7,400 gallons. Cone-bottom tanks provide fast

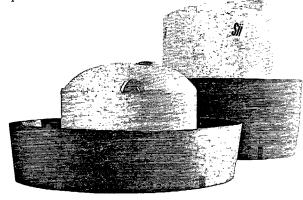
discharge and complete drainage and help keep materials in suspension from settling out. All cone-bottom tanks are available with heavy-duty steel frames.



Secondary Containment Basins

With the high cost of the materials that you store, plus the expense of chemical leaks and spills, it's obvious that quality secondary containment is a wise investment. Snyder offers rugged, secondary containment basins that are ideal to meet your storage tank requirements.

Two sizes are available. The 2,125-gallon basin protects storage tanks up to 1,675 gallons. The 3,775-gallon basin protects tanks up to 3,000 gallons. These highly portable basins are rotationally molded from high density or crosslinked polyethylene for years of dependable, trouble-free service.



Snyder containment basins are:

- ☐ Portable Easily moved when you need to reposition your tanks.
- Nestable Saves on shipping expenses.
- Durable These basins are rotationally molded from high density or crosslinked polyethylene for years of dependable, trouble-free service.

Vertical Tank Specifications and Applications

Tank Type	Stock* Number	Gallon Capacity	Diameter	Height
Agri-Tanks	153 –	22	17"	- 23"
	155 –	65	23"	44"
	154	200	40"	48"
	174 –	400	45"	62"
	180 -**	550	48"	75"
	167 –	550	64"	46"
	182 -**	550	64"	46"
	170 –	750	80"	42"
	181**	850	48"	: 114°
	183 -**	1,100	64"	87"
	171	1,100	86"	53"
	175 –	1,225	86"	61"
	177 –	1,500	86"	70"
	184 –**	1,550	64"	121"
	178	1,650	86"	77"
Utility Tanks	160 –	150	54"	22"
• · · · · · · · · · · · · · · · · · · ·	162 –	300	64"	29"
	165 –	465	64"	45"
Mini-Bulk Tanks	157-	70		24 1/2°
	161 –	110	36"	33"
	168 –	110	37"	39"
	169 –	110	37"	50"
	159 –	175	36"	50"
	5880 -	37	225"	42"
	5890 -	37	330"	57 1/2"
Bulk Storage Tanks	5050 -	2,100	90"	88"
Flat-Bottom Tanks	5090 -	2,600	90"	106"
Dome-Top	5130 -	3,000	90"	124"
Dome-rop	5210 -	4,600	90"	181"
	7000	5,900	120"	134"
	5250 -	6,200	142"	102"
	7140	6,900	120"	155"
	5300 -	7,650	142"	122"
	5330 -	10,500	142"	168"
	5350 -	12,500	142"	197"
	5370 -	15,000	142"	233"
	5390 -	22,000	142"	333"
Pulk Storage Tanks	188 –	500	86"	42"
Bulk Storage Tanks	189 –	1,000	86"	63"
Cone-Bottom (30°)	190 –	1,400	86"	76"
Dome-Top	191 –	1,775	86"	93"
	5070 -	2,100	90"	107"
	5110 -	2,650	90"	127"
	5150 -	3,000	90"	148"
	5280 -	6,900	142"	135"
45°Slope, 90" diameter Cone-Bottom	5320 -	8,250	142"	155"
Models also available in similar sizes.	5340 -	11,850	142"	213"

NOTE: All gallonages, weights and measures are nominal.

*The last two digits of the stock number designate material usage and color. 10=XL-Std. GN, 18=H.D.-Yellow, 27=XL-NAT., 37=H.D.-NAT., 38=H.D.-Kelly Green. **Includes 18" lid.

Snyder's Limited Warranty

All Snyder tanks must pass a set of rigorous Quality Assurance Checks before they leave our plant. For a full statement of the terms of our warranty, write:

Snyder Industries, Inc.

P.O. Box 4583, Lincoln, Nebraska 68504 Or phone: (402) 467-5221 — Fax (402) 467-3247



VT-1093-5M

Mini-Bulk Tanks

The Convenient Chemical Handling System That Saves You Money.

The Snyder Mini-Bulk System puts an end to the bother of handling farm chemicals in disposable containers — the lugging, rinsing, cutting and the hauling away. Mini-Bulk tanks allow for accurate metering, without the mess of 5-gallon cans, so it's easier to get proper application rates.

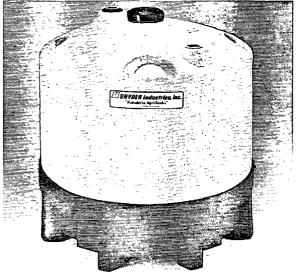
Just as important, Mini-Bulk saves the farmer money. It saves on packaging, on shipping and handling, and on the chemical waste that is inherent in disposable containers.

Snyder Mini-Bulk tanks are available in sizes to fit any operation — from 60 to 300 gallons.

110 and 175 Gallon

These economical tanks are designed for safe and easy chemical handling and transport. They are easily lifted and moved by forklift without being strapped to a pallet. The 110 and 175 are available in models that are exempted by the Department of Transportation for transport of hazardous materials and certain flammables (D.O.T. E-9690). Both tanks feature:

- Reinforcing gussets for added strength in forklift areas.
- Molded-in tie-down lugs for securing to truck bed.
- Big 6" threaded lid on standard model for easy fill and clean out.
- A replaceable bung insert at 2" opening.
- ☐ A polyolefin base available for increased stability and more convenient forklift handling.



Base is optional on 110 & 175 tanks.



New Generation II Mini-Bulk Now Available

This unique, totally redesigned mini-bulk incorporates several features specifically designed to assist anyone handling bulk chemicals and liquids.

- Recessed pump mounting area protects bung and pump mount openings, plus it protects the pump during transfer.
- Top Stacking Area In warehouse, allows stacking two high when full.
- Low center of gravity Designed to ease handling from fill point to distribution point.
- Available in custom colors, consult Snyder Industries.

One Piece Polyethylene Base

This unique 8-way entry base provides an extra layer of protection against tank damage. It comes standard on the Generation II Mini-Bulk and can be ordered as an optional accessory for the standard 110 and 175 mini-bulk (shown at left and above).

XL200 Mini-Bulk

This is Snyder's largest capacity standard mini-bulk tank. It is permitted by the U.S. Department of Transportation to transport corrosive and hazardous materials and certain flammables (D.O.T. E-8570).

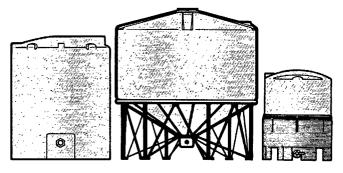


It also includes a cone-bottom for complete chemical discharge and is available in either a closed system or open system design. A stainless steel ball valve for positive shutoff is standard.

Its specially designed base allows it to be handled by a forklift, and molded-in tie-down lugs make it easy to secure the tank to a truck bed for transport.

Quality Theis Built In

If you're looking for quality, value and selection in liquid handling equipment, the long line of vertical tanks from Snyder Industries can play an important role in your operation.



Snyder is a leader in the rotational molding industry. We have produced more molded polyolefin ag tanks than any other manufacturer. Our Agri-Tank line has been tested and proven under the most demanding field conditions for more than 15 years. Our record of performance is your assurance that every Snyder tank you buy will give you years of trouble-free service. That's why Snyder Agri-Tanks have been North America's best selling tanks for more than 15 years. Snyder offers vertical tanks in a wide range of sizes and styles, for a variety of agricultural and industrial uses:

- □ Portable nurse tanks for flatbed or pickup trucks.
- ☐ Bulk liquid storage at stationary installations.
- □ Mini-bulk liquid handling systems.
- □ Injection of liquid herbicide and fertilizer in center pivot irrigation systems.

Every Snyder tank is rotationally molded from one of the industry's most advanced polyethylene resins. The result is one-piece seamless construction that is rugged enough to provide years of trouble-free service under the most demanding conditions. Snyder vertical tanks are available in sizes as small as 22 gallons, and as large as 22,000 gallons — the world's largest rotationally-molded vessel.

Choose From Two Field-Proven Materials

Each Snyder vertical tank is available in your choice of two superior tank materials:

Crosslinked Polyolefin

The most rugged material available in the rotational molding industry. Snyder pioneered the use of crosslinking polyolefin resin and has molded more of it into ag tanks than all other manufacturers combined. Unlike other molding materials, the molecules of this remarkable resin form a chemical bond, or crosslink, during the molding process. This crosslinking results in a product that is far stronger and more durable than any other molded polyethylene on the market.

Linear Resins

A more economical, but tough and durable material. The linear resin that Snyder uses was developed especially for use in agricultural and industrial tanks.

These outstanding materials produce tanks that are nonporous and highly resistant to stress cracking, chemical corrosion and cold-weather impact damage. Because these materials won't absorb chemicals like other tank materials, Snyder tanks significantly reduce problems with chemical cross-contamination that limit the versatility of other tanks.

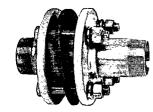
And because Snyder tanks don't corrode, dent or need painting like steel tanks, maintenance problems are virtually eliminated.

Snyder Accessories

Your Snyder dealer can supply you with all the proper hardware and support equipment needed for your Snyder tank. Accessories are specifically designed for each tank. They offer long-lasting durability, plus the convenience of a well-designed system.

Fittings

Snyder offers fittings for your Snyder tank in a variety of materials to meet your specific application.



Gaskets

EPDM or Viton gaskets are available for all Snyder fittings.

Siphon Tube

Allows for more complete drainage of liquids.

Stainless Steel Filter Housings (200-950 SCFM)



Enhanced Dryer Performance and Protection for your Compressed Air and Gas System.

Description

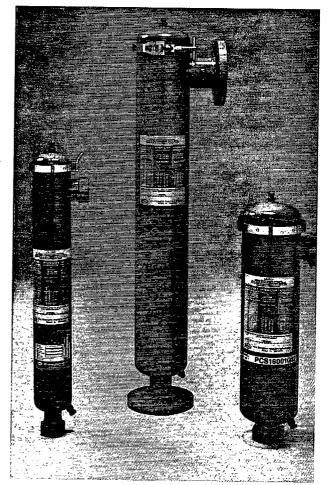
A series of 4" and 6", "L" type housings completely fabricated of 304 stainless steel for gas flows of 200 to 950 SCFM at 100 psig (higher flow rates at 250 psig). Designed specifically for use with PPC high performance air and gas filter cartridges.

Applications

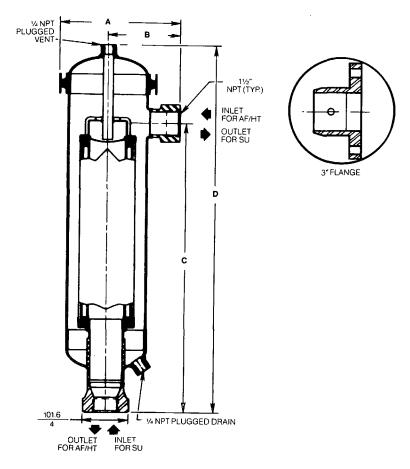
For use as coalescing or particulate filter housings for compressed air to 300 psig. May be used alone or as pre- and after-filters for a PPC regenerative adsorption dryer.

Features and Benefits

- Simple top-loading design for easy filter cartridge access. No need to disconnect drain valve or other tubing when changing cartridges.
- Stainless steel V-band locks cover to housing with captive seal for removal and attachment without tools.
- Stainless steel construction for longer housing life under adverse conditions.
- O-ring seals avoid leakage paths associated with tie-rod designs, which permit contamination downstream.
- Low housing ΔP saves dollars (a 1-psi pressure drop costs, on average, \$67 per year per 100 SCFM at 6¢ per KWH).
- Silicone cover seals permit use downstream of a head-reactivated or heaterless dryer.
- 1/4" NPT drain and vent ports enable housings to be used without expensive after-purchase modification.
- Single cartridge design for easy, rapid filter change-out.



Dimension and Pressure Drop Information



Nominal			Housing					Clearance		PSID*		Housing
SCFM*	Model No.	Conn. Size.	Diameter	A"	8"	, C"	. Đ"	Needed	Super S	SU	·	Dry
·								Above (in.)	Dry & Clean	Sat.	AF/HT Dry & Clean	Weight (lbs.)
					150 PSI	G DESIG	Erwin ner Terk			1. July 1		
200	PCS12001 G16		4"	6.1	3.6	14.3	18.4	24	.8	1.9	.3	8
340	PCS13401 G24		4"	6.2	3.8	25.6	30.1	24	.6	1.5		10
500	PCS15001 G24		6"	7.8	4.8	18.8	24.0	24	.9	2.1	.2 .3	14
600	PCS16001 G32		6"	8.7	5.2	20.0	25.2	24	.9	2.4	.3	18
800	PCS18001 G32		6"	8.3	5.3	35.3	40.6	34	.9	1.8	.5	20
950	PCS19501 G49	3" FLG	6"	10.5	7.0	37.8	43.5	34	1.0	2.0	.5	40
		Service Control of th		2.30	300 PSI	G DESIGI						
460	PCS32001 G16	1" NPT	4"	6.1	3.6	14.3	18.4	24	1.3	3.0	.7	8
		11/2" NPT	4"	6.2	3.8	25.6	30.1	24	.5	1.4		10
1150		T/2"NPT	6"	7.8	4.8	18.8	24.0	24	1.4	3.6	.2 .8	14
1385	PCS36001 G32	2" NPT	6"	8.7	5.2	20.0	25.2	24	1.3	3.5	:6	18
1840	PCS38001 G32		6"	8.3	5.3	35.3	40.6	34	1.0	2.0	.6	20
2190	PCS39501 G49	3" FLG	6"	10.5	7.0	37.8	43.5	34	.8	1.8	.5	40

^{*}SCFM and PSID at 100 psig and 250 psig, 100°F See Product Information Sheets 100C, 102C and 113 for filter cartridge selections and specifications.

Because of our policy of continuous improvement some information, specifications and dimensions contained herein may be revised. For confirmed accuracy, always refer to factory submittals.

PNEUMATIC PRODUCTS CORPORATION

OCALA, FLORIDA 32674 (904) 237-1220 TELEX: 441417 FAX (904) 854-1402 SERVING THE CHEMICAL, PETROCHEMICAL, PULP AND PAPER, AUTOMOTIVE, PRIMARY METALS, OIL AND GAS, POWER GENERATION, AND OTHER INDUSTRIES.

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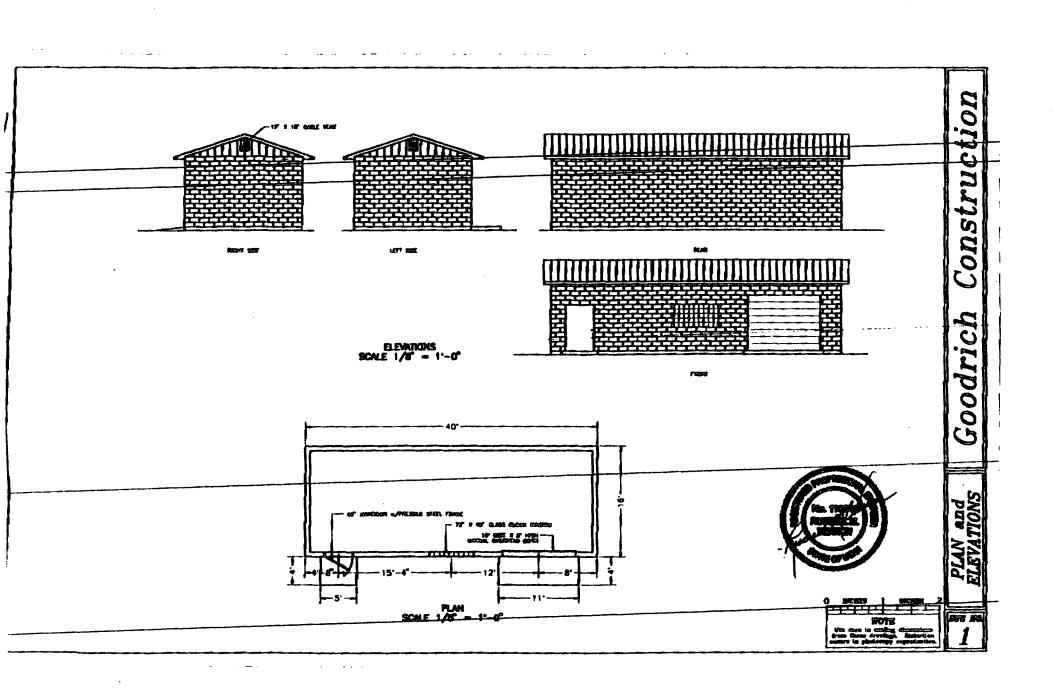
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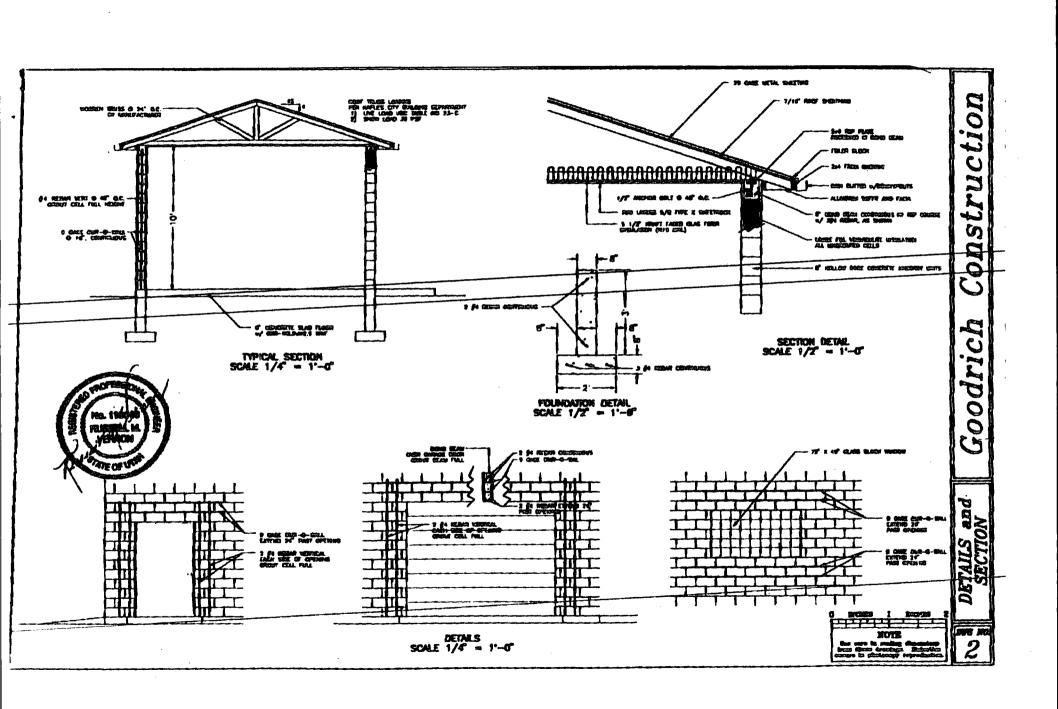
404 WEST 6110 SOUTH MURRAY, UT 84107

(801) 268- 2175

APPENDIX C-11

Treatment Building







Steel Tank Institute

Installation Instructions For Factory Fabricated Aboveground Tanks R912-91

Revised April 4, 1991

READ ALL INSTRUCTIONS BEFORE INSTALLATION

1.0 FOUNDATION PREPARATION

- 1.1 The foundation must be designed to support tanks on a well drained stable concrete, asphalt or bedding material which prevents movement, rolling or uneven settling of the tank, and is designed to minimize corrosion of the tank bottom.
- 1.2 For tank installations without corrosion protection, a static electricity grounding system should be installed for the tank in accordance with applicable National Association of Corrosion Engineers and applicable Electrical and Fire Code Standards.
- 1.3 For tank installations with corrosion protection, consult (NACE) recommended standards to provide the tank with appropriate protection from static electricity without disruption of corrosion protection.
- 1.4 Consult National Fire Protection Association publication NFPA 30, the Uniform Fire Code, and your local fire marshal and building inspectors for all applicable codes and restrictions such as spacing from buildings, property lines, public ways, etc.

2.0 TANK HANDLING

- **2.1** Equipment handling shall be of adequate size to lift and set tank without dragging or dropping.
- 2.2 Tanks shall be carefully lifted and set by use of cables or chains of adequate length attached to the lifting lugs provided.
- 2.3 <u>Do not</u> handle or install tank without knowledge of proper procedures and inherent dangers involved

with tank installation for storage of flammable and combustible liquids. Reliance on skilled, professional installers is an *important* factor in avoidance of system failures.

2.4 DO NOT MOVE TANK UNLESS EMPTY.

2.5 This is a stationary tank. Do not use for transport of any product over roads and highways.

3.0 AIR TEST

- 3.1 An on-site air test of the tank is required to insure no damage has occurred in shipping and handling.
- 3.2 To prepare the tank for the air test, remove all thread protectors and install metal pipe plugs properly prepared with compatible thread compound. Remove emergency vents and install properly prepared metal plug in the tank vent threaded opening. If a long-bolt (floating cover) manhole is used as an emergency vent, the top must be secured by temporarily installing regular bolts or other clamping devices.
- 3.3 For single wall tanks, Internal tank Air Test Pressure should not exceed 1½ pounds per square inch (PSIG) for vertical steel tanks and should not exceed 5 pounds

per square inch (PSIG) for horizontal tanks. A soap solution is to be applied to all exterior tank surfaces, including all weld seams and fittings, while the tank is pressurized to test for leaks.

3.3.1 CAUTION

TANKS CONTAINING AIR PRESSURE MUST NOT BE LEFT UNATTENDED. Atmospheric temperature could effect internal pressure.

3.3.2 Pressure gauges must be accurate (±2%) with a maximum gauge dial scale range of 15 pounds per square inch (PSIG).

3.0 AIR TEST (Continued)

- 3.3.3 Aboveground vertical tanks may have a "weak shell to roof" seam. Keep personnel away from the tank top during application of air pressure.
- 3.3.4 <u>DO NOT APPLY A VACUUM</u> TO THE PRIMARY TANK OR A SINGLE WALL TANK.
- 3.4 For double wall tanks consult tank manufacturer for air testing recommendations.
 - 3.4.1 <u>DO NOT CONNECT</u> the air pressure line from the compressor to the interstitial monitoring port

of a dual wall tank. Air pressure test the inner primary tank only.

- 3.4.1.1 For Type I dual wall tanks, vacuum testing of the interstital space of a dual wall tank can be used instead of, or in addition to, air pressure testing of the primary tank.
- 3.4.2 After air testing is completed, discharge compressed air from the tank before dismantling testing equipment and then re-install proper vents.

4.0 TANKS

- **4.1** All UL 142 listed tanks must have a means for emergency relief venting. Check with manufacturer for design type.
- **4.2** All tanks, including UL 142 listed tanks, must have a normal vent of adequate size for atmospheric venting (check local codes).
- 4.3 Install all permanent fittings and accessories. Use

compatible, non-hardening sealant material.

- **4.4** All unused openings must be properly plugged with threaded metal pipe plugs.
- 4.5 DO NOT MODIFY TANK STRUCTURE IN ANY WAY. DO NOT WELD ON TANK.

5.0 LABELING

- **5.1** Tanks shall be labeled in accordance with applicable regulations.
- 5.2 Unsupervised, isolated aboveground storage tanks shall

be secured and marked to identify fire hazards of tank and its contents to the general public. The tank area shall be protected from tampering or trespassing where necessary.

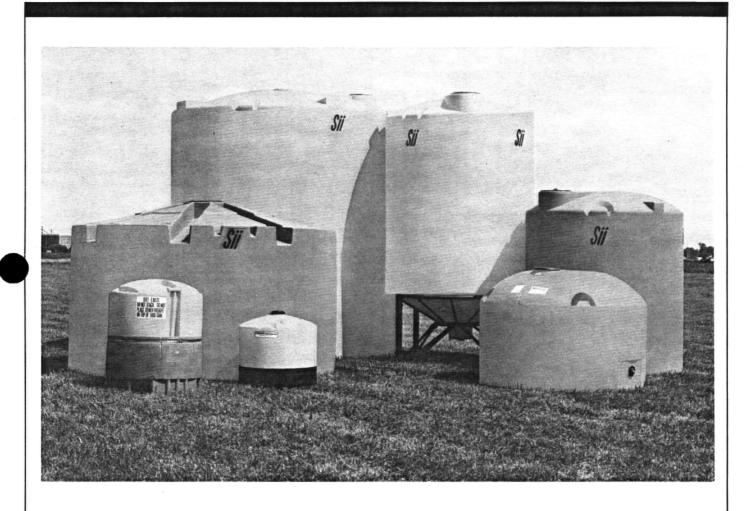
6.0 SECONDARY CONTAINMENT

- **6.1** Secondary containment may be steel, concrete or other approved material. Consult federal, state or local authorities.
- **6.2** Facilities shall be provided so that any accidental discharge of Class I, II or IIIA liquids will be prevented from endangering important facilities adjoining property or reaching waterways.
- 6.3 The secondary containment dike must be engineered for strength and sized to contain the greatest amount of liquid that can be released from the largest tank,
- plus the volume displaced by other tanks below the height of the dike. Local codes may require additional freeboard.
- 6.4 When steel secondary containment is employed, it is recommended that a suitable vehicle barrier be provided. One such method may typically be a 4-inch metal pipe "Bumper posts" filled with concrete installed at least 2 feet away from the tank, if the tank is subject to traffic damage. The pipe must be a minimum of 42 inches below ground level and 36 inches above ground level.

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Vertical Tanks





Portable Nurse and Liquid Transport Tanks

A number of Snyder's vertical tank models are well-suited for transporting liquids of all kinds, making them ideal for use as portable nurse tanks. Of course, many of the larger portable models are also suitable for stationary storage applications as well. These tanks offer the following standard features:

■ Large fill openings and 2" outlets for fast, easy draining of materials.

■ Ultraviolet inhibitors that help protect the tank and its contents from the sun's damaging rays.

■ Molded-in tie-down lugs for securing tanks.

■ Easy-to-read molded-in gallonage indicators that provide a convenient way to determine the volume of the tank's contents.

Siphon tubes to help drainage.



Agri-Tanks



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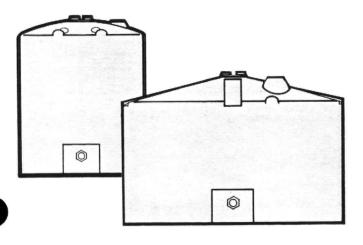
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- An 18" lid is standard. Larger sizes are available.
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- Color pigments and ultraviolet inhibitors help protect tank and contents from sun damage.

Flat-Bottom Tanks

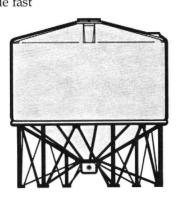
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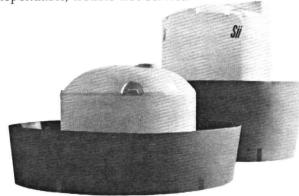
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Agri-Tanks	153 -	22	17"	23"
	155 –	65	23"	44"
	154 –	200	40"	48"
	174 –	400	45"	62"
	180 -**	550	48"	75"
	167 –	550	64"	46"
	182 -**	550	64"	46"
	170 -	750	80"	42"
	181 -**	850	48"	114"
	183 -**	1,100	64"	87"
	171 –	1,100	86"	53"
	175 –	1,225	86"	61"
	177 –	1,500	86"	70"
	184 -**	1,550	64"	121"
	178 -	1,650	86"	77"
Utility Tanks	160 -	150	54"	22"
,	162 -	300	64"	29"
	165 –	465	64"	45"
Mini-Bulk Tanks	157 -	70	attack consumer for	24 1/2"
	161 –	110	36"	33"
	168 -	110	37"	39"
	169 –	110	37"	50"
	159 –	175	36"	50"
	5880 -	37	225"	42"
	5890 -	37	330"	57 1/2"
Bulk Storage Tanks	5050 -	2,100	90"	88"
Flat-Bottom Tanks	5090 -	2,600	90"	106"
Dome-Top	5130 -	3,000	90"	124"
Some-Top	5210 -	4,600	90"	181"
	7000 -	5,900	120"	134"
	5250 -	6,200	142"	102"
	7140 -	6,900	120"	155"
	5300 -	7,650	142"	122"
	5330 -	10,500	142"	168"
	5350 -	12,500	142"	197"
	5370 -	15,000	142"	233"
	5390 -	22,000	142"	333"
Bulk Storage Tanks	188 -	500	86"	42"
	189 –	1,000	86"	63"
Cone-Bottom (30°)	190 -	1,400	86"	76"
Dome-Top	191 –	1,775	86"	93"
	5070 -	2,100	90"	107"
	5110 -	2,650	90"	127"
	5150 -	3,000	90"	148"
	5280 -	6,900	142"	135"
5° Slope, 90" diameter Cone-Bottom	5320 -	8,250	142"	155"
Models also available in similar sizes.	5340 -	11,850	142"	213"

NOTE: All gallonages, weights and measures are nominal.

*The last two digits of the stock number designate material usage and color. 10=XL-Std, GN, 18=H.D.-Yellow, 27=XL-NAT., 37=H.D.-NAT., 38=H.D.-Kelly Green. **Includes 18* lid.

Snyder's Limited Warranty

All Snyder tanks must pass a set of rigorous Quality Assurance Checks before they leave our plant.

For a full statement of the terms of our warranty, write:

Snyder Industries, Inc.

P.O. Box 4583, Lincoln, Nebraska 68504 Or phone: (402) 467-5221 — Fax (402) 467-3247



P.O. Box 4583, Lincoln, Nebraska 68504

Mini-Bulk Tanks

The Convenient Chemical Handling System That Saves You Money.

The Snyder Mini-Bulk System puts an end to the bother of handling farm chemicals in disposable containers — the lugging, rinsing, cutting and the hauling away. Mini-Bulk tanks allow for accurate metering, without the mess of 5-gallon cans, so it's easier to get proper application rates.

Just as important, Mini-Bulk saves the farmer money. It saves on packaging, on shipping and handling, and on the chemical waste that is inherent in disposable containers.

Snyder Mini-Bulk tanks are available in sizes to fit any operation — from 60 to 300 gallons.

110 and 175 Gallon

These economical tanks are designed for safe and easy chemical handling and transport. They are easily lifted and moved by forklift without being strapped to a pallet. The 110 and 175 are available in models that are exempted by the Department of Transportation for transport of hazardous materials and certain flammables (D.O.T. E-9690). Both tanks feature:

- Reinforcing gussets for added strength in forklift areas.
- Molded-in tie-down lugs for securing to truck bed.
- Big 6" threaded lid on standard model for easy fill and clean out.
- A replaceable bung insert at 2" opening.
- A polyolefin base available for increased stability and more convenient forklift handling.



Base is optional on 110 & 175 tanks.



New Generation II Mini-Bulk Now Available

This unique, totally redesigned mini-bulk incorporates several features specifically designed to assist anyone handling bulk chemicals and liquids.

- Recessed pump mounting area protects bung and pump mount openings, plus it protects the pump during transfer.
- Top Stacking Area In warehouse, allows stacking two high when full.
- Low center of gravity Designed to ease handling from fill point to distribution point.
- Available in custom colors, consult Snyder Industries.

One Piece Polyethylene Base

This unique 8-way entry base provides an extra layer of protection against tank damage. It comes standard on the Generation II Mini-Bulk and can be ordered as an optional accessory for the standard 110 and 175 mini-bulk (shown at left and above).

XL200 Mini-Bulk

This is Snyder's largest capacity standard mini-bulk tank. It is permitted by the U.S. Department of Transportation to transport corrosive and hazardous materials and certain flammables (D.O.T. E-8570).

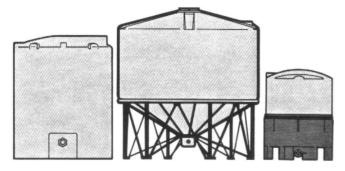


It also includes a cone-bottom for complete chemical discharge and is available in either a closed system or open system design. A stainless steel ball valve for positive shutoff is standard.

Its specially designed base allows it to be handled by a forklift, and molded-in tie-down lugs make it easy to secure the tank to a truck bed for transport.

Quality That's Built In

If you're looking for quality, value and selection in liquid handling equipment, the long line of vertical tanks from Snyder Industries can play an important role in your operation.



Snyder is a leader in the rotational molding industry. We have produced more molded polyolefin ag tanks than any other manufacturer. Our Agri-Tank line has been tested and proven under the most demanding field conditions for more than 15 years. Our record of performance is your assurance that every Snyder tank you buy will give you years of trouble-free service. That's why Snyder Agri-Tanks have been North America's best selling tanks for more than 15 years. Snyder offers vertical tanks in a wide range of sizes and styles, for a variety of agricultural and industrial uses:

- Portable nurse tanks for flatbed or pickup trucks.
- Bulk liquid storage at stationary installations.
- Mini-bulk liquid handling systems.
- Injection of liquid herbicide and fertilizer in center pivot irrigation systems.

Every Snyder tank is rotationally molded from one of the industry's most advanced polyethylene resins. The result is one-piece seamless construction that is rugged enough to provide years of trouble-free service under the most demanding conditions. Snyder vertical tanks are available in sizes as small as 22 gallons, and as large as 22,000 gallons — the world's largest rotationally-molded vessel.

Choose From Two Field-Proven Materials

Each Snyder vertical tank is available in your choice of two superior tank materials:

Crosslinked Polyolefin

The most rugged material available in the rotational molding industry. Snyder pioneered the use of crosslinking polyolefin resin and has molded more of it into ag tanks than all other manufacturers combined. Unlike other molding materials, the molecules of this remarkable resin form a chemical bond, or crosslink, during the molding process. This crosslinking results in a product that is far stronger and more durable than any other molded polyethylene on the market.

Linear Resins

A more economical, but tough and durable material. The linear resin that Snyder uses was developed especially for use in agricultural and industrial tanks. These outstanding materials produce tanks that are

These outstanding materials produce tanks that are nonporous and highly resistant to stress cracking, chemical corrosion and cold-weather impact damage. Because these materials won't absorb chemicals like other tank materials, Snyder tanks significantly reduce problems with chemical cross-contamination that limit the versatility of other tanks.

And because Snyder tanks don't corrode, dent or need painting like steel tanks, maintenance problems are virtually eliminated.

Snyder Accessories

Your Snyder dealer can supply you with all the proper hardware and support equipment needed for your Snyder tank. Accessories are specifically designed for each tank. They offer long-lasting durability, plus the convenience of a well-designed system.

Fittings

Snyder offers fittings for your Snyder tank in a variety of materials to meet your specific application.



Gaskets

EPDM or Viton gaskets are available for all Snyder fittings.

Siphon Tube

Allows for more complete drainage of liquids.

Stainless Steel Filter Housings (200-950 SCFM)



Enhanced Dryer Performance and Protection for your Compressed Air and Gas System.

Description

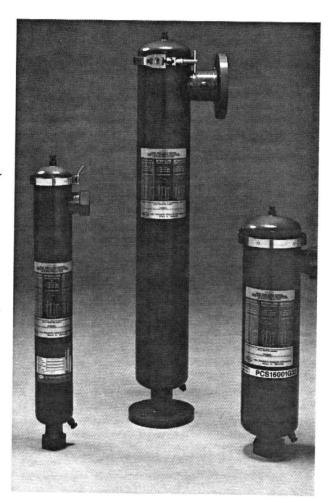
A series of 4" and 6", "L" type housings completely fabricated of 304 stainless steel for gas flows of 200 to 950 SCFM at 100 psig (higher flow rates at 250 psig). Designed specifically for use with PPC high performance air and gas filter cartridges.

Applications

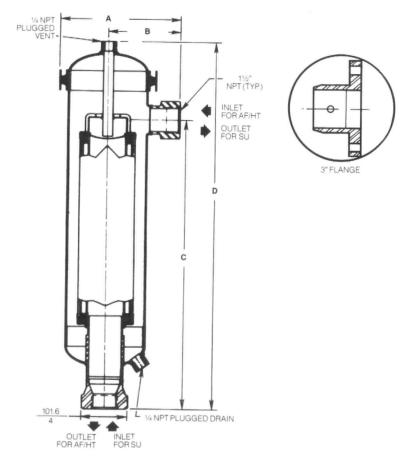
For use as coalescing or particulate filter housings for compressed air to 300 psig. May be used alone or as pre- and after-filters for a PPC regenerative adsorption dryer.

Features and Benefits

- Simple top-loading design for easy filter cartridge access. No need to disconnect drain valve or other tubing when changing cartridges.
- Stainless steel V-band locks cover to housing with captive seal for removal and attachment without tools.
- Stainless steel construction for longer housing life under adverse conditions.
- O-ring seals avoid leakage paths associated with tie-rod designs, which permit contamination downstream.
- Low housing ΔP saves dollars (a 1-psi pressure drop costs, on average, \$67 per year per 100 SCFM at 6¢ per KWH).
- Silicone cover seals permit use downstream of a head-reactivated or heaterless dryer.
- 1/4" NPT drain and vent ports enable housings to be used without expensive after-purchase modification.
- Single cartridge design for easy, rapid filter change-out.



Dimension and Pressure Drop Information



Nominal	Model No.	Conn. Size.	Housing				19593	Clearance	PSID*			Housing
SCFM*	Model No.	Conn. Size.	Diameter	A"	B"	C"	D"	Needed	Super	SU		Dry
								Above (in.)	Dry & Clean	Sat.	AF/HT Dry & Clean	Weight (lbs.)
					150 PSI	G DESIG	N					
200 340 500 600 800 950	PCS12001 G16 PCS13401 G24 PCS15001 G24 PCS16001 G32 PCS18001 G32 PCS19501 G49	1" NPT 1½"NPT 1½"NPT 2" NPT 2" NPT 3" FLG	4" 4" 6" 6" 6" 6"	6.1 6.2 7.8 8.7 8.3 10.5	3.6 3.8 4.8 5.2 5.3 7.0	14.3 25.6 18.8 20.0 35.3 37.8	18.4 30.1 24.0 25.2 40.6 43.5	24 24 24 24 24 34 34	.8 .6 .9 .9 .9	1.9 1.5 2.1 2.4 1.8 2.0	.3 .2 .3 .3 .5 .5	8 10 14 18 20 40
					300 PSI	G DESIG	N					
460 785 1150 1385 1840 2190	PCS32001 G16 PCS33401 G24 PCS35001 G24 PCS36001 G32 PCS38001 G32 PCS39501 G49	1½" NPT 1½" NPT 2" NPT 2" NPT	4" 4" 6" 6" 6"	6.1 6.2 7.8 8.7 8.3 10.5	3.6 3.8 4.8 5.2 5.3 7.0	14.3 25.6 18.8 20.0 35.3 37.8	18.4 30.1 24.0 25.2 40.6 43.5	24 24 24 24 24 34 34	1.3 .5 1.4 1.3 1.0	3.0 1.4 3.6 3.5 2.0 1.8	.7 .2 .8 .6 .6	8 10 14 18 20 40

*SCFM and PSID at 100 psig and 250 psig, 100°F See Product Information Sheets 100C, 102C and 113 for filter cartridge selections and specifications.

Because of our policy of continuous improvement some information, specifications and dimensions contained herein may be revised. For confirmed accuracy, always refer to factory submittals.

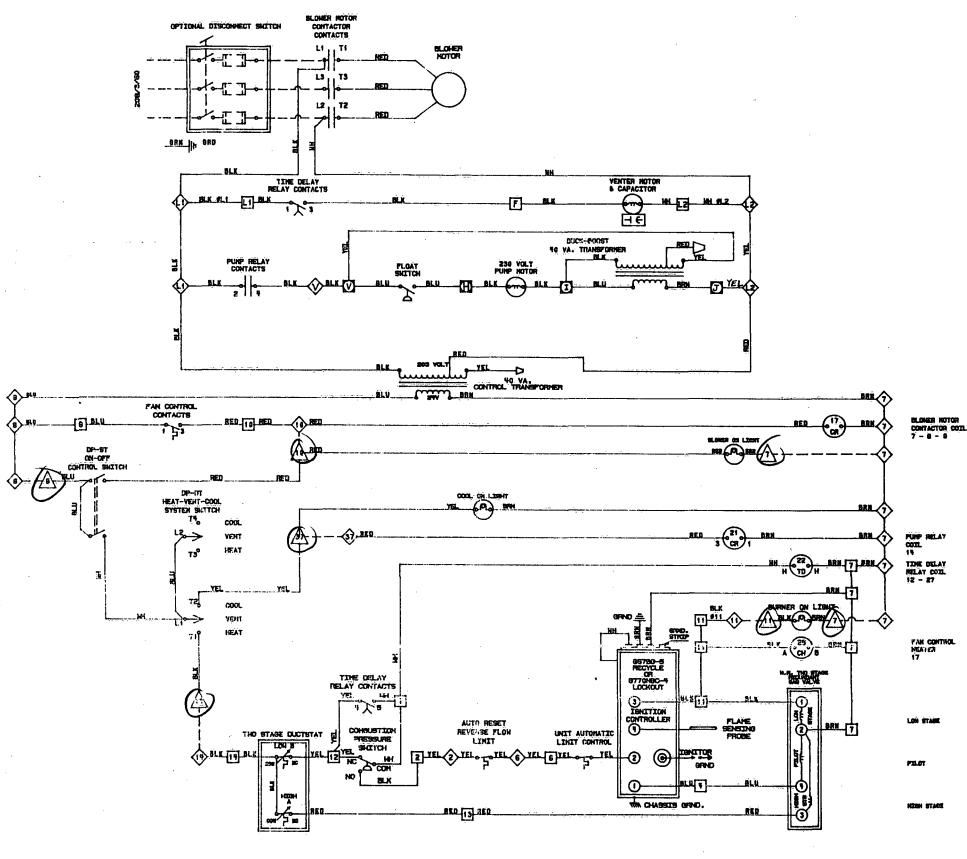
PNEUMATIC PRODUCTS CORPORATION

OCALA, FLORIDA 32674 (904) 237-1220 TELEX: 441417 FAX (904) 854-1402 SERVING THE CHEMICAL, PETROCHEMICAL, PULP AND PAPER, AUTOMOTIVE, PRIMARY METALS, OIL AND GAS, POWER GENERATION, AND OTHER INDUSTRIES.

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DISTRIBUTED BY:





OPERATING SEQUENCE

- 1. SET CONTROL SHITCH AT "OFF" POSITION.
 2. TUEN ON POWER AND NAMUAL GAS VALVE TO UNIT.
 3. VENTILATION OPERATION
 1. SET CONTROL SHITCH AT "ON" POSITION, SYSTEM SHITCH AT "VENT" POSITION.
 (A) ENERGIZING THE BLOWER MOTOR.
 (B) LIGHTING BLOWER ON LIGHT.
 4. COLUMN OPERATION
- COOLING OFFENTION

 1. SET CONTROL SHITCH AT "CN" POSITION, SYSTEM SHITCH AT "COOL" POSITION.

 (A) FREEEZOUS DES BLOWER MOTOR.
- (A) ENGRANATE THE SECOND FULL THE PROPERTY OF PARTY THE PARTY LEVEL FLOAT SALTON (C) ENGRACIZING THE FURP. MITTOR IN SERIES WITH THE PARTY LEVEL FLOAT SALTON (C) COC. ON LIGHT IS LIT.

 5. HEATING OPERATION
- HEATING OPERATION

 1. SET CONTROL SHITCH AT "ON" POSITION, SYSTEM SHITCH AT "HEAT" POSITION.

 (A) ENERGIZING THE BLOHER HOTOR.

 (B) LIGHTING BLOHER ON LIGHT.

 (C) PIRTING RATE IS CONTROLLED BY THE TWO STAGE TEMPERATURE

 CONTROLLER (HITH BLLB IN DISCHARGE AIR).

 (D) BURNER ON LIGHT IS LIT WHEN UNIT IS FINGURE.

 SET CONTROL SHITCH AT "OFF" POSITION FOR SHUTDOWN.

 (A) PAN CONTROL KEEPS THE BLOHER HOTOR ON HHILE UNIT IS HOT.

5-14057

B-111395

- FIRING SEGIENCE:

 1. ON A CALL FOR HEAT BY THE LOW STAGE OF CONTROLLER.

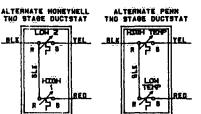
 (A) THE VENTER HOTOR IS ENERGIZED AFTER A 15 SECOND (APPROX.)

 THE DELAY.

 (B) VENTER FLOW SECTION SECTIONS PROM N.C. TO N.O. CONTAINS ENERGIZED THE PLLOT GAS VALVE AND SPARK GAP TO PRODUCE A PILOT FLANE ON EACH OPERATING CYCLE. THE SENSING PROBE PROVED THE PRESENCE OF THE PILOT FLANE AND ENERGIZED THE SAFETY SECTION PORTION OF THE CONTROL. THE SHITCH ACTION DE-ENERGIZES THE SPARK GAP AND ENERGIZES THE MAIN VALVE. THE HAIN GAS ENAMES AND THE UNIT FIRES AT LOW RATE.

 2. ON A CALL FOR HEAT BY THE HIGH STAGE OF CONTROLLER LATT FIRES ATT FILL RATE.

 3. If THE FLANE IS EXTINGUISHED DURING HAIN BURNER OPERATION THE SAFETY SHITCH CLOSES THE MAIN VALVE AND RECYCLE THE SPARK GAP. ON UNIT EQUIPPED MITH GYTONGO-1 LOCKOUT CONTROL. IF FILLOT IS NOT ESTABLISHED MITHON 120 SECONDS (APPROX.) UNIT LOCKS SUT AND MUST BE RESET BY INTERPUTING FOMER TO CONTROL CIRCUIT (SEE LIGHTING INSTRUCTIONS).



NOTE

- 1. THE FOLLOHING CONTROLS ARE SUPPLIED BY REZNOR FOR FIELD INSTALLATION: CONSOLE 2. THE FOLLOHING CONTROLS ARE SUPPLIED AS OPTIONAL EQUIPMENT:

- DISCONNECT SHATCH

 3. COTTED IGRORG AND THE FOLLOHOUS CONTROLS ARE SUPPLIED AND INSTALLED BY OTHERS: NOME

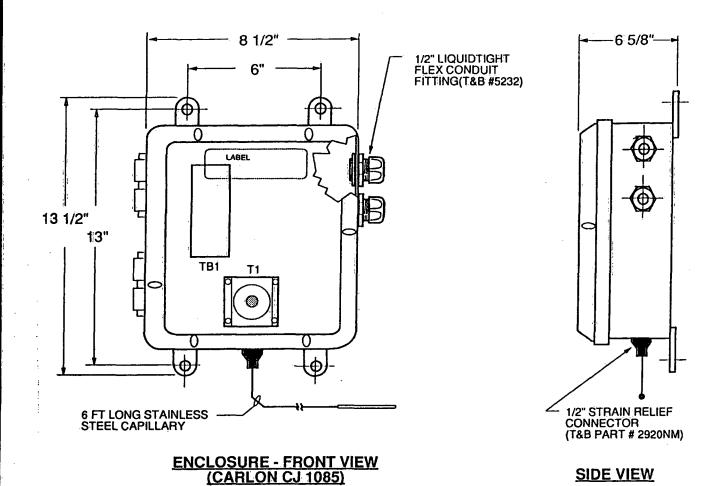
 4. CAUTION: IF ANY OF THE ORIGINAL HOPE AS SUPPLIED MITH THE APPLIANCE HUST BE REPLACED, IT HUST BE REPLACED MITH MORING MATERIAL HAVING A TEPFRATURE RATING OF AT LEAST 105 DESPREES C. EXCEPT FOR SURENSY CUT-OFF OR SENSOR LEAD HURE MICH MUST BE 150 DESPREES C.

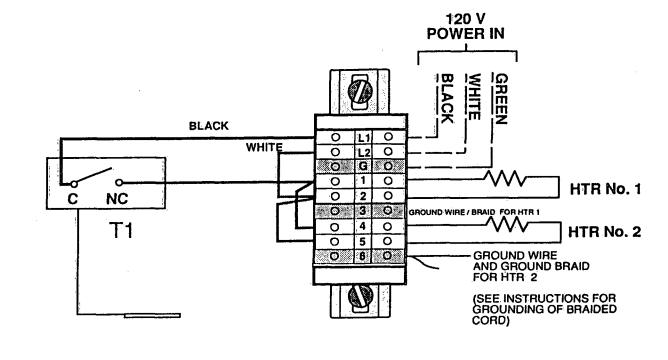
 5. LINE AND BLOKER HOTOR BRANCH CURCUIT HORE SIZES SHOULD BE OF A SIZE TO PREVENT OF SUPPLY LINE VOLTAGE.

 6. USE 918 GA. KURE FOR 24 VOLT CONTROL HURING ON UNIT.

 7. USE 914 GA. KURE FOR LINE AND MOTOR HURING ON UNIT.

FTELD (CONTROL	HIPTING
TOTAL HOPE LENGTH	Н	NITHE SIZE
150 FEET		#18 BA.
250 PEET		#16 GA.
350 FEET		614 BA.
منت المنافق ال		ORY KURUNG
	FIEL	D KURUNG
- x x	X. орт1	ONAL FACTORY KURDINS
	-i oprz	ONAL FIELD HORONS
7,8,10,11,19 & 37	∇	TERRODAL BLOCK — REM CON
V,H,I & 3		TERHIDIAL BLOCK RAH UNIT
2,6,7,8,10,11, 14,37,6,L1 & LZ	\Diamond	TERRODAL BLOCK BLOHER COMPARTMENT
1,2,4,6,7,8,10, 11,12,13,14,F,L1 & L2		TERKÍNAL BLOCK HEATER COMPARTHENT





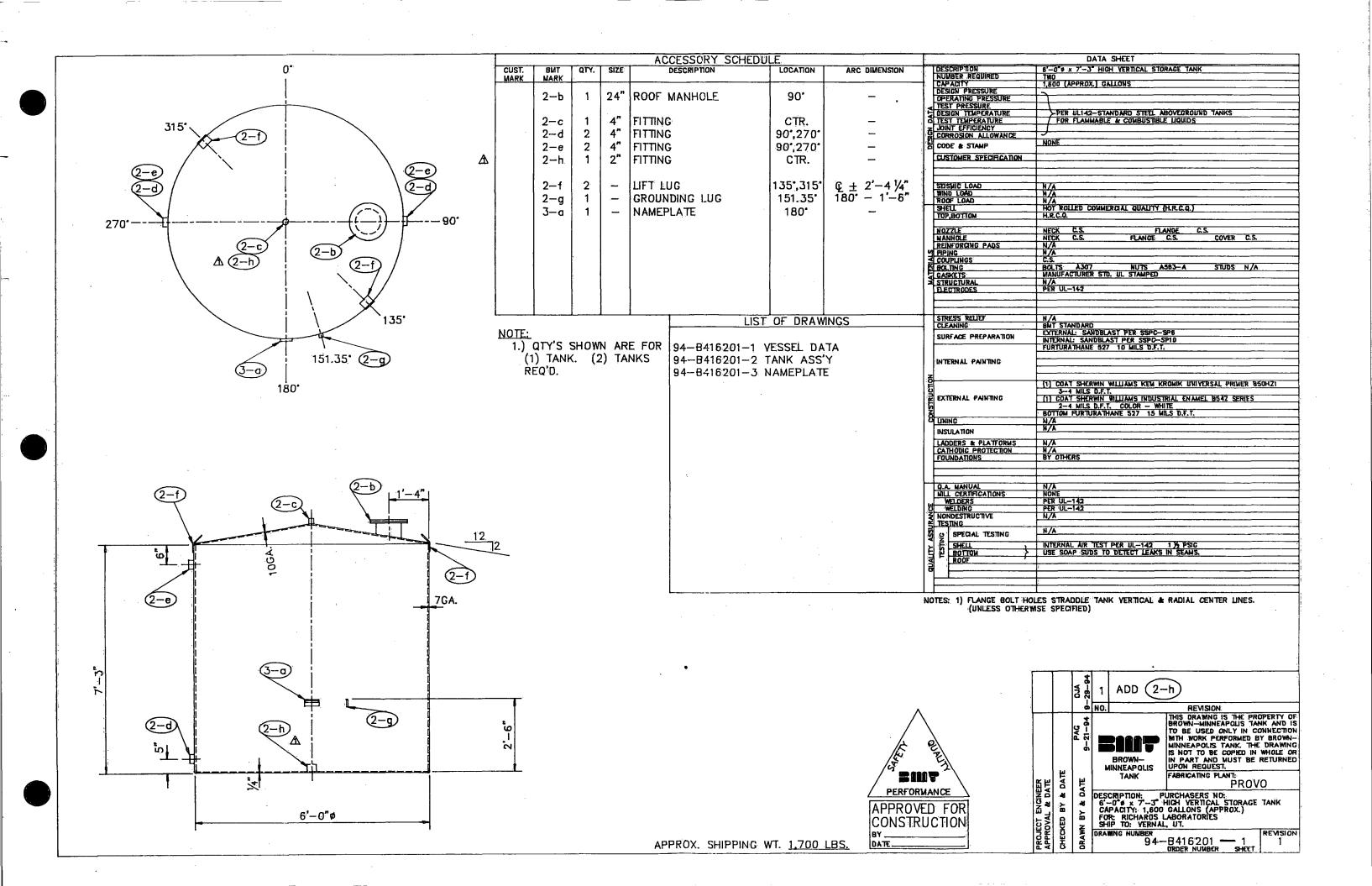
WIRING SCHEMATIC

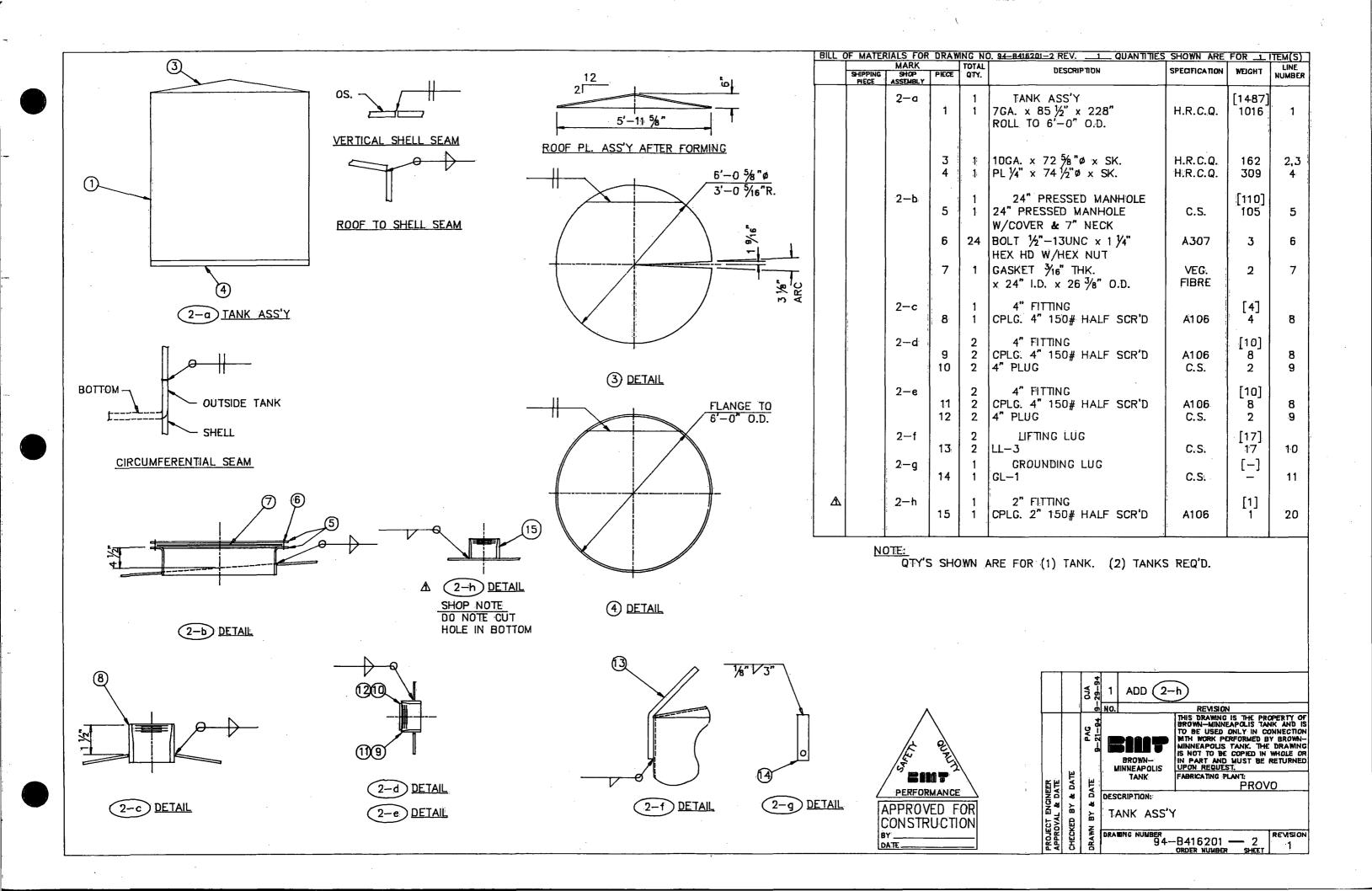
JB-1-150-2-RT

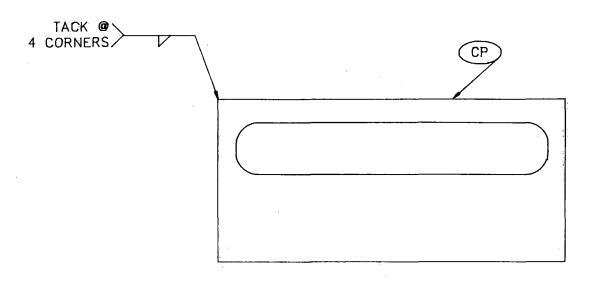
NOTES:

- 1. T1 THERMOSTAT IS UNITED ELECTRIC MODEL E55S-14086.
 2. TB1 = ENTRELEC M6/8 TERMINAL BLOCKS. GROUND BLOCK IS M6/8.P.
 3. THIS DRAWING FOR ORDINARY AREA APPLICATIONS
 USING 2 RT FLEXIPANEL HEATERS. (RT-1021)
 4. 14 AWG WIRE MINIMUM.

							·		
L								TITLE:	THIS DRAWING IS THE PROPERTY OF THERMON - WEST PROJECT NO.
								CONTROL SYSTEM	AND MUST NOT BE MADE PUBLIC OR COPED AND ALL CONTROLS IS SUBJECT TO BETURN ON DEMAND ALL DIRAYS. AND CONTROLS
		1						ORDINARY AREAS	OF DESIGN OR INVENTION ARE RESERVED. P.O. 101961
	Ţ,							2 HEATER APPLICATION	
									(HERMON) EL DOPADO HILLS CALIFORNIA 4925 - 01
RE	V.	DATE	DESCRIPTION OF REVISION	DRAWN	DESIGNED	REVIEWED	APPROVED	SCALE:	THE HEAT TRACING SPECIALISTS OF O





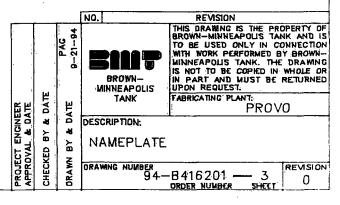


3-a DETAIL

Ţ	BILL C	F MATER	NALS FOR	DRAW		. 94-B675101-3 REVO_QUANTITIES	SHOWN ARE	FOR _1	TEM(S)
ĺ	}	SHIPPING	MARK SHOP	PIECE	TOTAL QTY.	DESCRIPTION	SPECIFICATION	WEIGHT	LINE NUMBER
١,		PIECE	ASSEMBLY		-				
:			3-a		1	NAMEPLATE		[-]	
	1			:CP	1	LABEL BRACKET - NO LABEL		_	12
;						*			
									:
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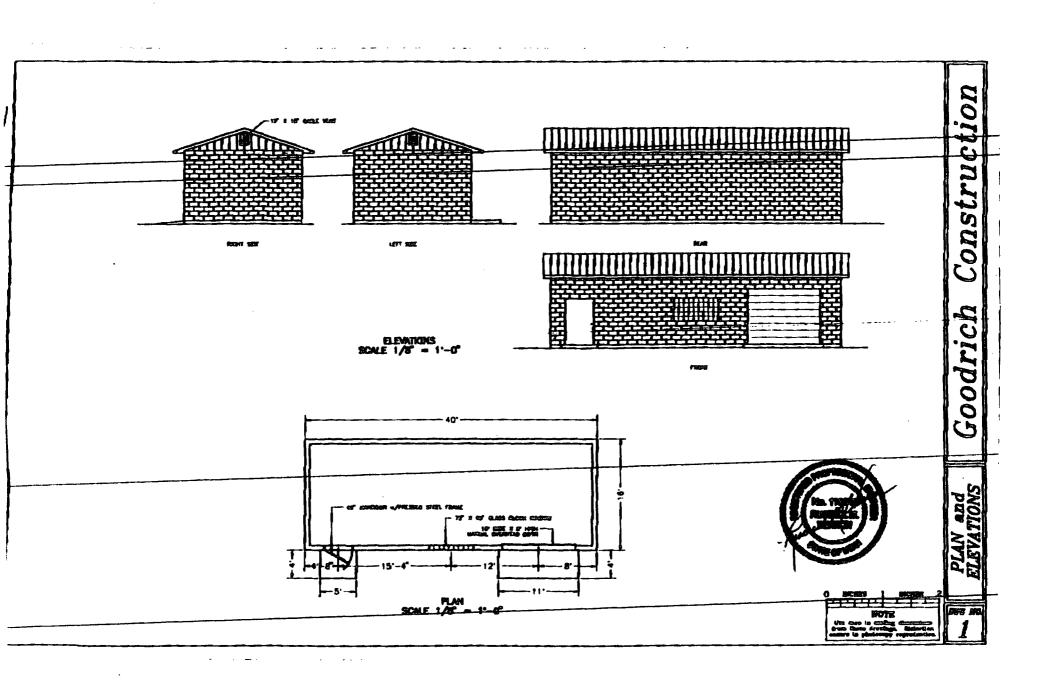
NOTE: QTY'S SHOWN ARE FOR (1) TANK. (2) TANKS REQ'D.

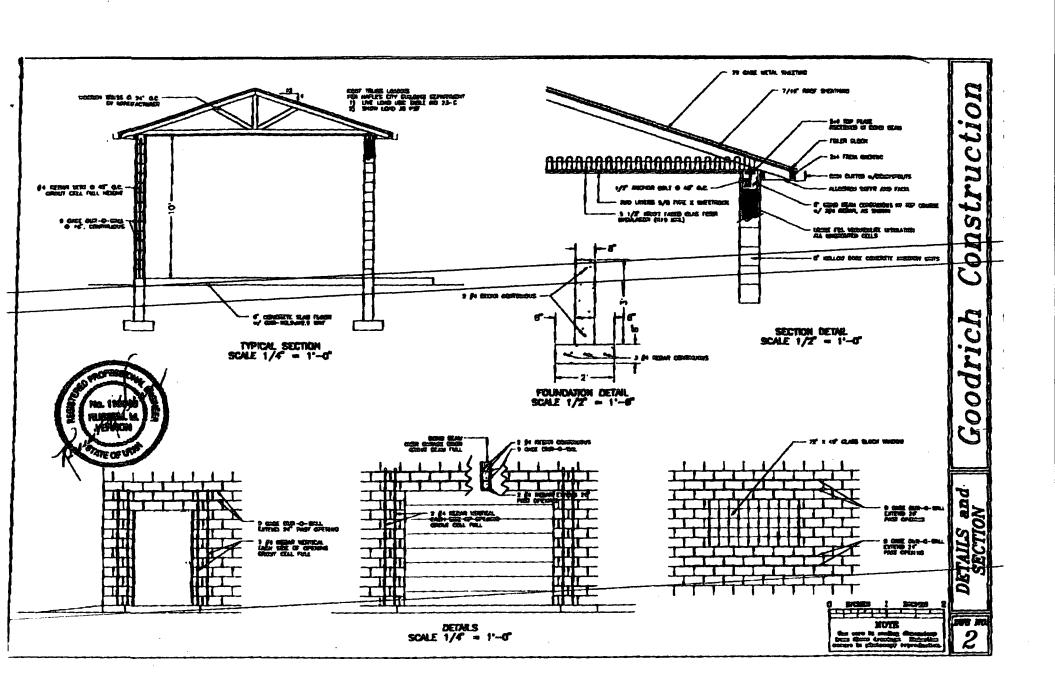




APPENDIX C-11

Treatment Building







PHILADELPHIA, PA 19115
PHONE: (215) 484-8900 FAX: (215) 877-1647 TELEX: 83-4545

OPERATING INSTRUCTIONS & PARTS MANUAL

HEAVY DUTY REVERSIBLE SUPPLY/EXHAUST FANS, WITH REVERSING SWITCH

MODELS BX12Q, BX14Q, BX16Q, BX16T, BX18Q, BX18T, BX20Q, BX20T, BX24Q, BX24T

READ INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO ASSEMBLE, INSTALL, OPERATE OR SERVICE PENN VENTILATOR BELT DRIVE FANS.

RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE!

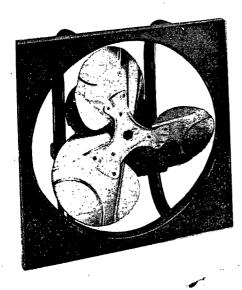


Figure 1

Description

The Penn Ventilator Model BX Heavy Duty Reversible Supply/Exhaust Fan for wall and duct mounting is designed for use in commercial and industrial applications. Each fan is equipped with a ball bearing, totally enclosed, automatic thermal overload protected, electrically reversible motor. Unit is furnished with painted steel venturi and aluminum propeller.

WARNING: IF FANS ARE LOCATED LESS THAN 7 feet above the floor, guarding is required in accordance with OSHA (Occupational Safety and Health Act) requirements.

General Safety Information

WARNING: DISCONNECT POWER BEFORE SER-VICING OR INSTALLING.

WARNING: THIS FAN SHOULD BE ASSEMBLED AND INSTALLED BY A QUALIFIED TECHNICIAN.

- Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
- 2. Motor must be properly grounded.
- Lock and tag power disconnect to prevent resumption of power disting maintenance.
- 4. Guard all moving parts.
- Be careful when touching the exterior of an operating motor; it may be hot enough to be painful or cause injury. With modern motors this condition is normal if operated at rated load and voltage. Modern motors are built to operate at higher temperatures.
- 6. Protect the power cable from coming in contact with sharp objects.
- Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces, or chemicals.
- 8. Make certain that the power source conforms to the requirements of your equipment.
- Keep cleaning rags and other flammable waste materials in a tightly closed metal container and dispose of later in the proper fashion.
- Use an approved cleaning agent, such as dry cleaning solvent, for cleaning electrical or electronic equipment.

Performance Data (Air Intake)

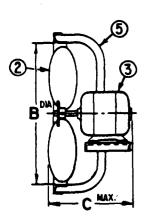
MODEL		FAN		TIP	FAN C	AP. IN CUBIC	FEET PER MIN	. (CFM)	SONES
MODEL D.D.	HP	FAN DIA.	RPM	SPEED (FPM)	0.000" SP	0.125" SP	0.250" SP	0.375" SP	@ .125"
				 	CFM	CFM	CFM	CFM	
BX12Q	1/6	12"	1725	5423	1400	1260	1050	805	4.0
BX14Q	1/6	14"	_ 1725	6327	2000	1780	1580	1150	11.0
BX16T	1/6	16"	1140	4779	2255	1885	1390	650	7.2
BX16Q	1/3	10	1725	7231	3035	2760	2550	2250	13.0
BX18T	1/4	18"	1140	5376	3100	2670	2100	820	8.2
BX18Q	1/3] 10	1725	8135	3500	3040	2275	1400	12.8
BX20T	1/4	20"	1140	5974	3800	3160	2590	2240	9.3
BX20Q	1/3	20″	1725	9039	3750	3440	3200	2560	14.0
BX24T	1/3	24"	1140	7168	4720	4540	3855	3000	14.8
BX24Q	1/2	24	1725	10847	4650	4400	3800	3480	20.0

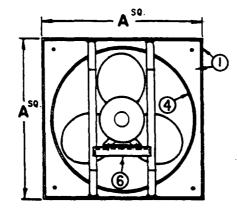
Performance Data (Air Exhaust)

BX12Q	1/6	12"	1725	5423	1125	815	675	530	4.0
8X14Q	1/6	14"	1725	6327	1565	1395	1205	920	11.0
BX16T	1/6	16"	1140	4779	1995	1520	1000	600	7.2
BX16Q	1/3	10	1725	7231	2530	2345	1835	1430	13.0
BX18T	1/4	18"	1140	5376	2365	2040	1605	625	8.2
BX18Q	1/3	10	1725	8.35	3000	2480	1980	1285	12.8
BX20T	1/4	20"	1140	5974	2705	2265	2130	1835	9.3
BX20Q	1/3	20	1725	9039	3070	2835	2540	2245	14.0
BX24T	1/3	24"	1140	7168	3610	3475	2945	2295	14.8
BX24Q	1/2	24	1725	10847	3555	3365	2905	2660	20.0

Performances shown are for units without inlet and outlet ducts.

Dimensional Data





Dimensions

MODEL NO	A	В	CMAX
BX12Q	141/2	12¾	12
BX14Q	16½	14¾	12
BX16Q	19	16¾	121/2
BX16T	19	16¾	121/2
BX18Q	21	18¾	12¾
BX18T	21	18¾	123/4
BX20Q	23	20¾	131/2
BX20T	23	20¾	131/2
BX24Q	27	24¾	131/2
BX24T	27	24¾	131/2

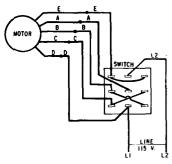
All Dimensions in Inches.



- 1. Connect motor per nameplate to correct power supply.
- 2. Install all wiring, protection and grounding in accordace with National Electrical Code and local requirements.
- 3. Follow all electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
- 4. In order to prevent motor failure unit must be started on or reverse from "off" position.



REVERSING SWITCH



Unpacking

When unpacking the fan, inspect carefully for any damage that may have occurred during transit. Check for possible loose parts, missing parts or damaged parts.

Installation

CAUTION: These fans have rotating members that require use of safety precautions during installation, operation and maintenance.

WARNING: IF FANS ARE LOCATED LESS THAN SEVEN (7) FEET ABOVE THE FLOOR, A GUARD IS REQUIRED IN ACCORDANCE WITH OSHA (OCCUPATIONAL SAFETY AND HEALTH ACT) REGULATIONS.

 The fan should be securely mounted within a rigid framework to prevent flexing or movement of the fan frame during operation. The fan frame should be equally supported on all sides within the framework and caution should be taken to avoid twisting or cocking of the fan frame during installation.

CAUTION: Allowing the fan frame to flex or move during operation will create harmful vibrations which may damage the unit.

 Fans should be mounted in opening within 1/4" clearance around perimeter. Venturi framing should be secured to building structure utilizing corrosion resistant fasteners.

NOTE: Prop is protruding from front of panel and special precautions must be taken during installation to prevent bending of the prop.

Check rotation after wiring of ventilator to be sure airflow direction corresponds to information as listed on the switch.

Dampers, if used, must be mechanically operated and clear prop by at least 2". Dampers, if used, must be mechanically operated and clear prop by a least 2". Fan motor could overheat if operated with damper in closed position.

Operations

With air system in full operation, measure correct input (amps) to motor in both directions and compare with nameplate rating to determine if motor is operating under safe load conditions.

When reversing directions, switch should go to the OFF position FIRST, then after Prop stops, change switch to other direction.

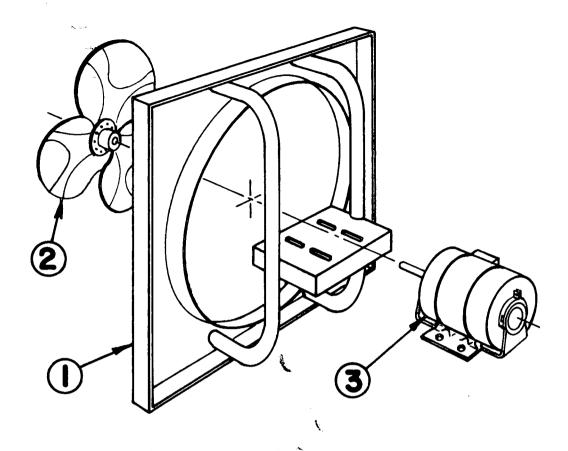
Fan should not be used in Hazard location. Refer to the National Electrical Code Para 500 for definition of Hazardous locations.

Maintenance

CAUTION: Make certain that the power source is disconnected before attempting to service or disassemble any components! If the power disconnect is out-of-sight, lock it in the OFF position and tag to prevent application of power. Periodically clean any guards, dampers, motors and prop to prevent decrease in airflow and overheating motor, and make sure all bolts are tight.

Trouble Shooting Chart

SYMPTOM	POSSIBLE CASE(S)	CORRECTIVE ACTION
Excessive noise	Defective motor bearing.	Replace motor.
	2. Crooked or damaged prop.	2. Replace prop.
	Motor not securely fastened.	3. Tighten motor.
	4. Loose propleller.	4. Align and tighten prop to motor shaft.
Fan inoperative	Blown fuse or open circuit breaker.	Replace fuse or circuit breaker.
• • • • • • • • • • • • • • • • • • • •	2. Loose or disconnected wiring.	Shutoff power, check wiring for proper connections.
	3. Defective motor.	3. Repair or replace motor.



Replacement Parts List

REF.		PART NO. FOR MODEL:										
NO.	DESCRIPTION	BX12-1	BX14-1	BX16-1	BX16-2	BX18-1	BX18-2	BX20-1	BX20-2	BX24-1	BX24-2	
1	Painted Steel Panel	26312-3	26313-3	26314-3	26314-3	26315-3	26315-3	26316-3	26316-3	26317-3	26317-3	
2	Propeller	50521-0	50516-0	50517-0	50518-0	50522-0	50526-0	50523-0	50524-0	50519-0	50527-0	
3	Totally Enclosed Motor	60288	60288	60291	60289	60291	60290	60291	60290	60293	60292	

LIMITED WARRANTY

PENN VENTILATOR CO., INC. ONE-YEAR LIMITED WARRANTY. Heavy duty reversible supply/exhaustfans. Models BX12 through BX24 are warranted by Penn Ven-Tilator Co., Inc. to the original user against defects in workmanship or materials under normal use for one year after date of purchase. Any part which is determined by PENN to be defective in material or workmanship and returned to the factory as PENN designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at PENN's option. For limited warranty claim procedures, see PROMPT DISPOSITION below. This limited warranty gives purchasers specific legal rights

of replaced at PENN's option. For initially want any claim processing, see Final State which vary from state to state.

LIMITATION OF LIABILITY. To the extent allowable under applicable law, PENN's liability for consequential and incidental damages is expressly disclaimed. PENN's liability in all events is limited to, and shall not exceed, the purchase price paid.

WARRANTY DISCLAIMER. PENN had made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are products in the product of the prod

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purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.

use will comply with them.

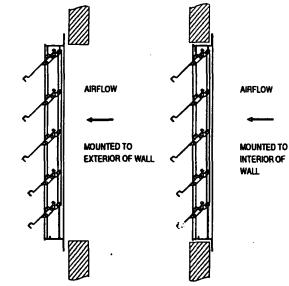
Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you, and (c) by law, during the period of this Limited Warranty, any implied warranties of merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION. PENN will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to PENN at address below, giving dealer's name, address, date and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.

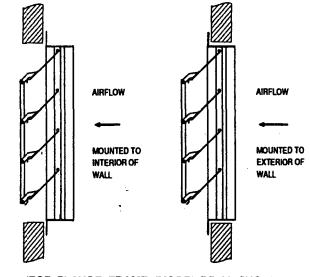
PENN VENTILATOR CO., INC. RED LION AND GANTRY ROADS, PHILADELPHIA, PA. 19115

INSTALLATION INSTRUCTIONS

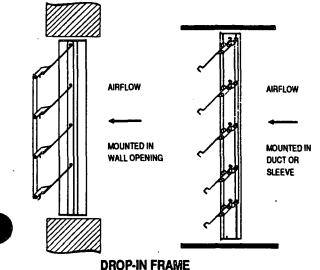
TYPICAL MOUNTING ARRANGEMENTS FOR VERTICALLY MOUNTED BACKDRAFT DAMPERS



STANDARD FLANGE FRAME (MODEL BD-16 SHOWN)



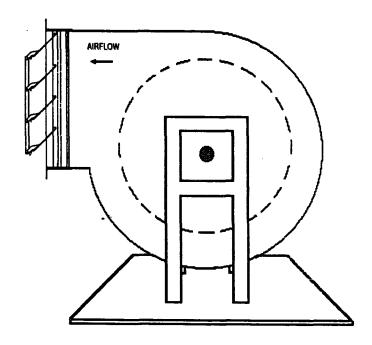
REVERSE FLANGE FRAME (MODEL BD-20 SHOWN)



(MODEL BD-20 SHOWN)

(MODEL BD-16 SHOWN)

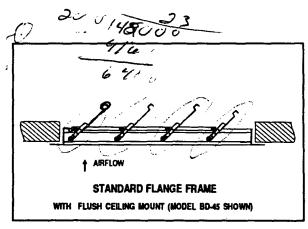
- Backdraft dampers should be mounted plumb, square and in a single plane. Care should be taken not to twist the jambs, thereby, putting a bind in the bearings. Care should also be taken not to bow the jambs either in or out. Bowing the jambs out can allow the shafts to come out of the bearings. Bowing the jambs in can put excess pressure on the bearing shoulders, thereby, causing a bind.
- 2. After the damper is installed, open and close it several times manually to be sure it is operating freely.
- If the damper came with an electric actuator attached, be sure the damper is installed with the actuator on the inside of the building (out of the weather). The actuator should be wired to a proper voltage source.
- 4. If the damper is supplied with a motor kit, follow the installation instructions that came with the kit. The actuator must be located inside the building (out of the weather) and wired to a proper voltage source.
- If the damper came with a manual chain operator, find a convenient point below the damper and mount the chain claw. The claw must be installed within the reach of the chain.
- Other models may have either no linkage or linkage of a different design. Be sure air flow is in a direction that will open the damper blades.

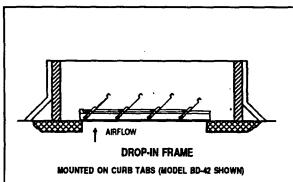


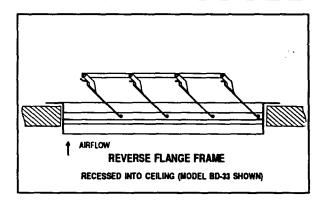
UTILITY SET MOUNTING (MODEL BD-36 SHOWN)

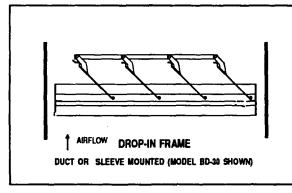
INSTALLATION INSTRUCTIONS

TYPICAL MOUNTING ARRANGEMENTS FOR HORIZONTALLY MOUNTED BACKDRAFT DAMPERS (WITH AIR FLOW UP).









- Backdraft dampers should be mounted horizontally, square, and in a single plane. Care should be taken not to twist the jambs, thereby putting a bind in the bearings. Care should also be taken not to bow the jambs either in or out. Bowing the jambs out can allow the shafts to come out of the bearings. Bowing the jambs in can put excess pressure on the bearing shoulders, thereby causing a bind.
- 2. After the damper is installed, open and close it several times manually to be sure it is operating freely.
- 3. If the damper came with an electric actuator attached, be sure the damper is installed with the actuator mounted above the plane of the closed blades. The actuator must be mounted so it is protected from the weather by a roof ventilator or building (attic) space. The actuator should be wired to a proper voltage source.
- 4. If the damper is supplied with a motor kit, follow the installation instructions that came with the kit. The actuator must be located above the plane of the closed blades, protected from the weather and wired to a proper voltage source.
- If the damper came with a manual chain operator, find a convenient point below the damper and mount the chain claw. The claw must be installed within the reach of the chain.
- Other models may have either no linkage or linkage of a different design. Be sure air flow is in a direction that will open the damper blades.

APPENDIX C-12

Treatment Building Heater and Heat Tracing

DUCT FURNACE / BLOWER UNIT FOR COMMERCIAL / INDUSTRIAL HEATING AND MAKEUP AIR



CLEARANCES FROM COMBUSTINLES

Unit top to overhange - 36".

Furness bottom - 0°, (When installed on a roof curb on a combuelible surface, the roof area enclosed within the curb must be either ventilated, left open, or severed with non-combustible material which has an "R" value of all test 5.0.)

TECHNICAL DATA

Size	125	150	175	200	225	250	300	350	400
BTUH Input	125,000	150,000	175,000	200,000	225,000	250,000	300,000	_	400,000
Thermal Output Capacity *	96,250	115,500	134,780	154,000		182,500	231,000	269,500	
Unit Amps (Less motor) 115V	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Control Amps (24V)	.95	.95	.95	.96	.95	.95	.95	.95	.95
A.G.A. CFM Range - RPB	980-1175	1175-1410				1960-2350			
A.G.A. CFM Range - HRPB **	1175-3800	1410-4700	1645-5000	1880-5100	2116-5150	2350-5800	2920-8300	2205-5800	9766-710
C.G.A. CFM Range - RPB	1100-1765	1320-2115	1540-2470	1765-2020	1985-3175	2205-3630	2645-4235	3085-4940	3830-584
C.G.A. CFM Range - HRPB ☆☆	1765-3800	2115-4700	2470-6000	2820-5100	3175-5150	3530-5800	4235-6300	4940-5500	8845-710
(H)-RPB Not Weight (Lbs.) ★☆☆	482	520	520	534	534	688	588	630	662
(H)-RPB Ship Weight (Lbs.) ★★★	622	677	677	714	714	617	817	874	830
Gas Connection-Natural ★★★	1/2*	1/2"	1/2*	1/2"	1/2*	1/2"	3/4	3/4*	3/4"
				(1) 16x20	(1) 16x20				(8) 30×20
Fitter Size (Filters are Optional		(2) 16x20		1,,		(1) 20x20	(1) 20±20		
and Available in 1° or 2°	(1) 20x25	(2) 16x25	(2) 18x25	(1) 18x25	(1) 16x25	(3) 20x25	(3) 20x25	(2) 18x26	(1) 16×2
disposable, permanent, or pleated)	(1) 25×25				(1) 20x26			1	(2) 20x2

- A.G.A. ratings for altitudes to 2000 feet. Above 2000 feet de-rate by orifice change, 4% for each 1000 feet above sea level. C.G.A. ratings for altitudes to 2000 feet. High altitude units (2001 to 4500 feet) are de-rated by 10% of maximum input.
- ## Prefix 'H' Indicates high CFM units without directional linger baffles.

क्षेत्र Prenx 'H' Indicates night Grief units whitout directional imper salines.

★★☆ Weights shown are for packaged furnace and blower.

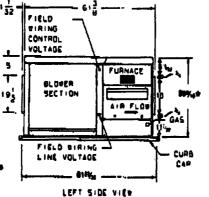
★★★ Gas connections for optional propens is 1/2 inch for all sizes.

Sizes shown are for gas connection to a single-stage gas valve, not gas supply line size.

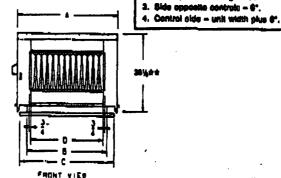
<u>W</u>MENSIONS CPTIDNAL TOOK OUTS OF `31<u>!!</u> HOOD

NOTES:

- 1. Reznor designed optional outside at head of eveporative coaling module is
- 2. Sumer and control scool side (fiscing stretream). Specify right side (Option A.2) for apposite side access and connections.



PLENUM



ell ripe with optic	PS 1 1	hh Planyk	į		
FIELD	\				
BLONER E SECTION	FURNACE AIR FLOS	OPTIONAL DOMARTIEN PLBNUM	391/40		30%**
OPTIONAL / ARTURN AR	GAS		CURB CAP	FRONT VIE	▃▃▋▗ ▗ ╌┫┢╙┇ ₩

1974 1994	26% 26%	35%	20% 20%
2	26%	35%	267
77/4	364	45%	34%
13%	42%	50%	40
40%	47%	661/6	451/2
rge Air	Opening	- 16 ± C	
inchers.	o Air One	nino — 11	W 2.5
	19 19	19 - 19% x B	13% 42% 50% 16% 17% 42% 50% 16% 17% 186% 17% 186% 17% 186% 17% 186% 17% 186% 17% 18% 18% 18% 18% 18% 18% 18% 18% 18% 18

MODEL MEE A

Curb Cop Bissensiets with Coplings Copling Call Cabinal (not Hastrated)		
	Langth	Width
Unit with cooling coll sabinet (Option AU1)	0717/10"	Store m
Unit with Downlym Planum (Option AQS) and Cooling Coll Cabinet (Option ALIT)	11196	8emp es
For dimensions of coll cabinet dust opening, see Form 9-Coil		